VICTORIA ISLAND CARIBOU MIGRATIONS ACROSS DOLPHIN AND UNION STRAIT AND CORONATION GULF FROM THE MAINLAND COAST, 1976-94

Northwest Territories Resources, Wildlife & Economic Development

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GOVERNMENT OF THE NORTHWEST TERRITORIES

YELLOWKNIFE, NWT

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Manuscript Report No. 94

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103-06919/

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ABSTRACT

We compiled incidental caribou (*Rangifer tarandus*) sightings that record a resumption of the historic migration between Victoria Island and the mainland since at least 1976. The increasing harvest of 'island' caribou on the mainland and possible shipping route proposed through the Dolphin and Union Strait and Coronation Gulf prompted us to document the extent of the caribou movement in 1993. We surveyed the area between Victoria Island and mainland Northwest Territories (NWT) in April and May using a helicopter. We counted caribou, tracks and determined trail concentrations on the sea-ice. We estimated that more than 2500 caribou were crossing north to Victoria Island and an additional 4700 animals were preparing to cross. Concentrations of caribou feeding and resting along the mainland coast and island shorelines suggest caribou use these areas to feed intensively before crossing. Most movement probably occurs at night. Caribou moved north in higher numbers from the mainland earlier in the western part of the Coronation Gulf than at Kent Peninsula. The largest concentrations of caribou moving on sea-ice were on May 8 in the western part of the gulf where we observed 605 caribou and 9 tracks. The numbers of moving caribou were still high among the Jameson Island chain by May 11. The greatest movement at Kent Peninsula occurred during May 18 when we saw 322 caribou and 393 tracks. Many groups of caribou were still moving in this area after the survey period. Caribou used different crossing strategies depending on ice conditions encountered. Hunters reported Victoria Island caribou as far east as Melbourne Island in western Queen Maud Gulf and in March 1994, we estimated 719 ± 83 (Standard Error) caribou and counted 62 caribou on Melbourne and Minto islands. Our observations during the 1980s and 1990s emphasise the importance of islands in the Coronation and western Queen Maud Gulf as staging areas in early spring for caribou migrating from the mainland back to Victoria Island.

TABLE OF CONTENTS

ABSTRACT iii

LIST OF FIGURES vii

LIST OF TABLES ix

INTRODUCTION 1

METHODS 6

RESULTS 8

DISCUSSION 36

RECOMMENDATIONS 41

ACKNOWLEDGEMENTS 42

PERSONAL COMMUNICATIONS 43

LITERATURE CITED 44

APPENDIX A Summary of weather conditions during observations of caribou migrations in the Coronation Gulf region, April 30 - May 18, 1993 46

APPENDIX B. Caribou and muskox observations in the Coronation Gulf region, April 30 - May 18, 1993 47

APPENDIX C. Observations of muskoxen on and off transect during an aerial survey of Melbourne Island, Northwest Territories, 11 March 1994 . . . 72

APPENDIX D. Caribou observed on transect during an aerial survey of Melbourne Island, Northwest Territories, 11 March 1994 73

APPENDIX E. Weather and technical details of Melbourne Island survey . . . 74

LIST OF FIGURES

Figure 1. Coastal regions surveyed during observations of caribou migrations between Victoria Island and the mainland NWT, April 30 - May 18, 1993 4

Figure 2. Area surveyed during observations of caribou migrations between Victoria Island and the mainland NWT, April 30 - May 18, 1993 . . . 5

Figure 3. Caribou monitoring flight routes over Coronation Gulf, April 30, May 5, 8, 1993 16

Figure 4. Observations of caribou on sea ice and direction of travel, Bernard Harbour, Coronation Gulf, April 30, May 5, 1993 17

Figure 5. Location and direction of caribou trails, Coronation Gulf and Dease Strait, April 30, May 5, 8, 1993 18

Figure 6. Observations of caribou on sea ice and direction of travel, Coronation Gulf, May 8, 1993 20

Figure 7. Caribou monitoring flight routes over Coronation Gulf, May 10-11, 1993 21

Figure 8. Observations of caribou on sea ice and direction of travel, Kent Peninsula and Couper Islands, May 10, 1993 22

Figure 9. Observations of caribou on sea ice and direction of travel, Coronation Gulf and Dease Strait, May 11-12, 1993 23

Figure 10. Location and direction of caribou trails, Coronation Gulf and Dease Strait, May 11-13, 1993 24

Figure 11. Caribou monitoring flight routes over Dease Strait, May 12-13, 1993 25

Figure 12. Observations of caribou on sea ice and direction of travel, Dease Strait, May 13, 1993 27

Figure 13. Caribou monitoring flight routes over Kent Peninsula and Jameson Islands, May 18, 1993 28

Figure 14. Observations of caribou on sea ice and direction of travel, Kent Peninsula and Jameson Islands, May 18, 1993 29

Figure 15. Location and direction of caribou trails on the western end of Coronation Gulf, May 18, 1993 30

Figure 16. Muskox observations, Coronation Gulf area, April 30 - May 18, 1993 32

Figure 17. Reconnaissance flight lines and transect lines on Minto and Melbourne Islands, NWT, March 1994 33

LIST OF TABLES

Table 1. Victoria Island caribou observed on islands and mainland as evidence for inter-island migration, 1976 - 1986 9

Table 2. Summary of caribou sightings and tracks counted during a ferry flight between Cambridge Bay and Kugluktuk over the sea-ice along the Victoria Island south coast, 2 June 1989 10

Table 3. Summary of caribou sightings and tracks reported by helicopter pilots flying the Kugluktuk area as part of the Coronation Gulf Hydrometric Survey as noted by George Fawcett, prior to this study, March 30 - April 25, 1993 10

Table 4. Summary of observations, transect lengths and survey details for estimated Victoria Island caribou numbers, March 1993, Kent Peninsula 11

Table 5. Summary of observed groups of caribou migrating between Victoria and mainland, NWT, April 30 - May 18, 1993 12

Table 6. Caribou activities observed during helicopter surveys, April - May, 1993 12

Table 7. Observations during snowmachine trip from Kugluktuk to Cambridge Bay, May 24, 1993 14

Table 8. Muskox herds in the Coronation Gulf region, April 30 - May 18, 1993 31

Table 9. Analysis of data from an aerial survey of Victoria Island caribou on Melbourne Island, 11 March 1994 34

Table 10. Analysis of data from an aerial survey of muskoxen on Melbourne Island, 11 March 1994 34

INTRODUCTION

Tens of thousands of caribou used to cross from southern Victoria Island to the mainland in the fall and return in spring (Manning 1960). The migration across Dolphin and Union Strait prompted Manning (1960) to name the herd after the strait. Although he had only had skulls and skins to work from Manning recognized that caribou from the Dolphin-Union herd were distinctive from barren-ground (*R.t. groenlandicus*) and Peary caribou (*R.t. pearyi*).

The caribou migrations to and from the mainland halted abruptly in the early 1900s and for several decades, there were few caribou on southern Victoria Island. By the 1970s, Inuit hunters were reporting that more caribou were returning to the south coast of Victoria Island (Gunn 1990). Hunters reported that these caribou were distinctive in appearance and in this report we refer to those caribou as Victoria Island caribou, abbreviated to 'island' caribou. Elsewhere, we describe the similarity in skull between these and the Dolphin-Union specimens from the early 1900s (Gunn and Fournier 1996).

Our need to describe the inter-island movements is threefold. Firstly, the movements bring Victoria Island caribou within the reach of hunters from two communities (Kugluktuk and Umingmaktok). The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) classifies Victoria Island caribou as "threatened" and we are working with the Nunavut Wildlife Management Board to monitor the caribou harvest (J. Nishi unpubl. information).

Secondly, proposed developments include a port at Kugluktuk and ore-carriers along Dolphin and Union Strait and Coronation Gulf (NPCTT 1996). At this stage the ore-carrier passages are planned for late June to October which should not overlap with the caribou crossings. Baseline information is required, nevertheless, to plan for the ships' passages as caribou are known to sometimes cross when ice conditions are less than suitable (Miller and Gunn 1985) and disturbance could then compound any problems for the caribou.

Thirdly, among the predictions for global warming is an earlier break-up and a later freeze-up for sea ice. Those changes would change migration routes and timing and to predict or detect those changes we need baseline information.

Our study objectives were to determine areas of concentrations of trails crossing the sea-ice between the south coast of Victoria Island and the mainland and to obtain an index for the numbers of tracks and the extent of the movement.

Initially, we also wanted to determine if snow conditions and forage availability differed in late winter on the southern Victoria Island coast and the mainland coast but time was insufficient and we only collected some data on diet. This is reported elsewhere in a compilation on caribou and muskox ecology on southern Victoria Island (Gunn and Sutherland in prep.).

Our report presents information on caribou migration between Victoria Island and the mainland from sightings and surveys up until 1994. However, more information on the migration is documented from tracking radio-collared

caribou. At the time of publishing this report, the radio-tracking project is unfinished and will be reported separately (J. Nishi unpublished data).

In 1994, the Ekaluktutiak Hunters' and Trappers' Association in Cambridge Bay reported that caribou on Melbourne Island were mostly Victoria Island caribou and the island is an important staging area in early spring for caribou migrating from the mainland back to Victoria Island. Hunters were also concerned that muskoxen may be locally overabundant on Melbourne Island.

In this report, we summarize earlier evidence for the resumption of the migration of Victoria Island caribou to the mainland. We report caribou and tracks observed on the sea-ice and coasts during a helicopter survey in May 1993, the results from an aerial survey of caribou on Kent Peninsula in March 1993 and Melbourne Island in March 1994. Place names mentioned in the text are shown in Figures 1 and 2.

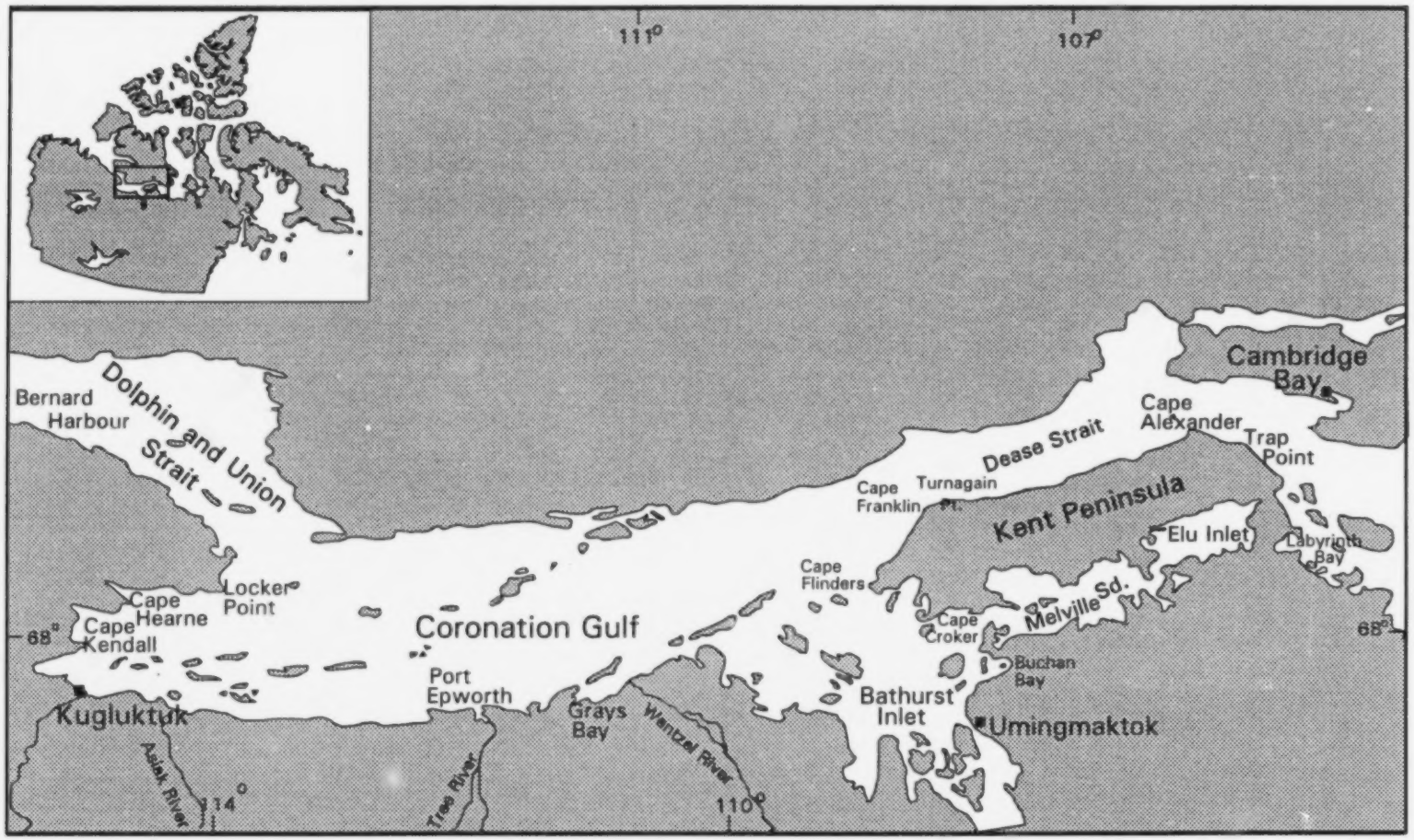


Figure 1. Coastal regions surveyed during observations of caribou migrations between Victoria Island and the mainland NWT, April 30 - May 18, 1993.

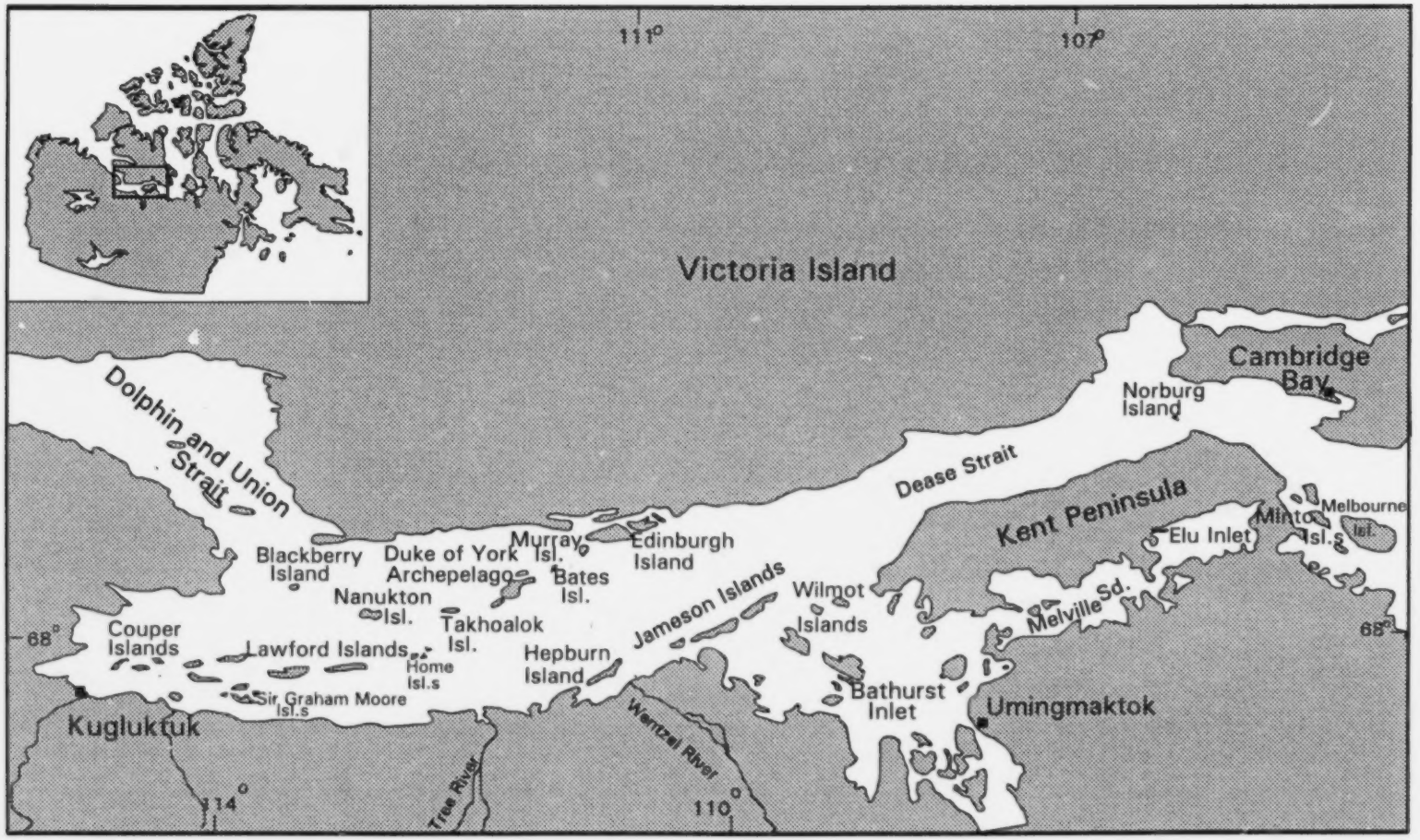
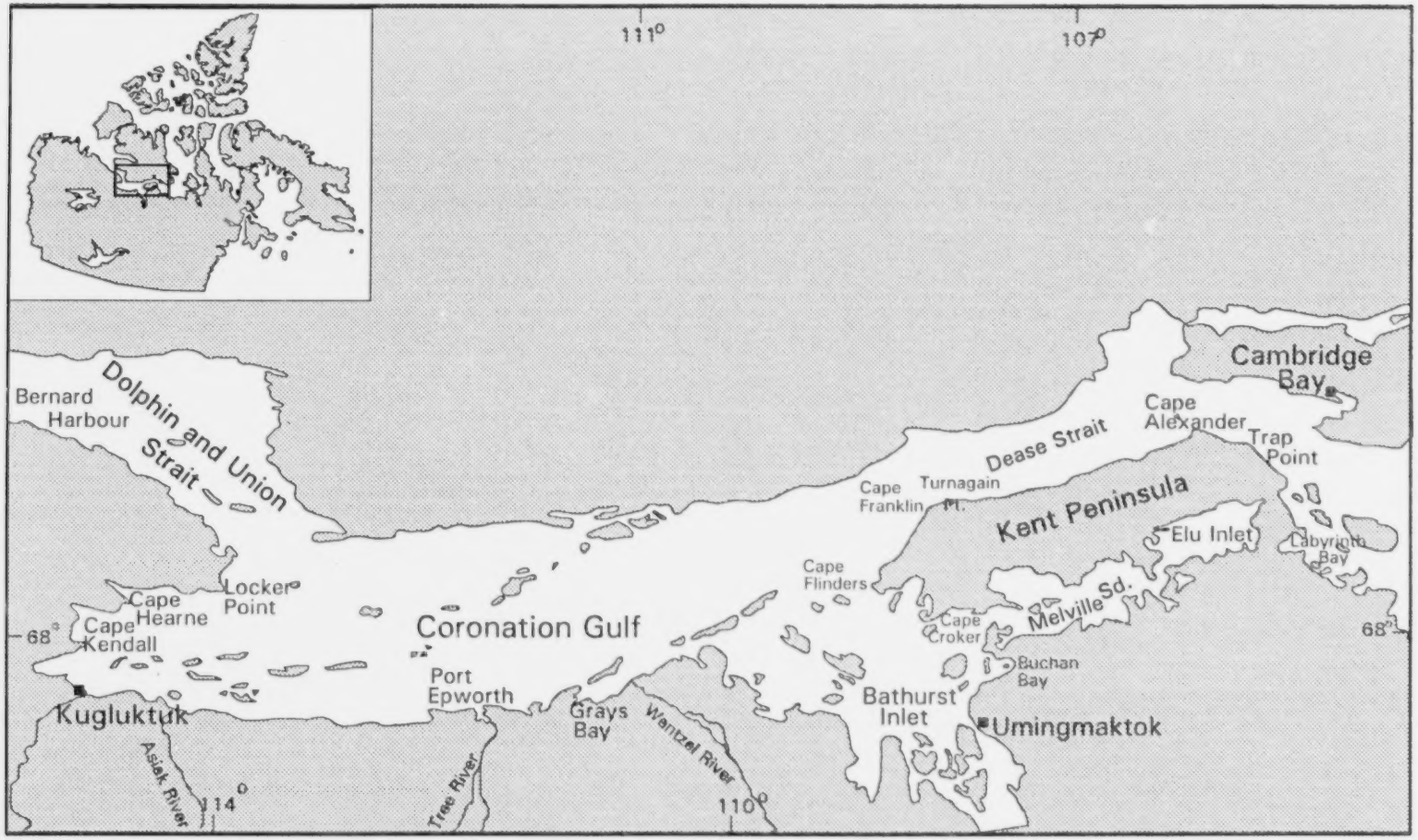


Figure 2. Area surveyed during observations of caribou migrations between Victoria Island and the mainland NWT, April 30- May 18, 1993.



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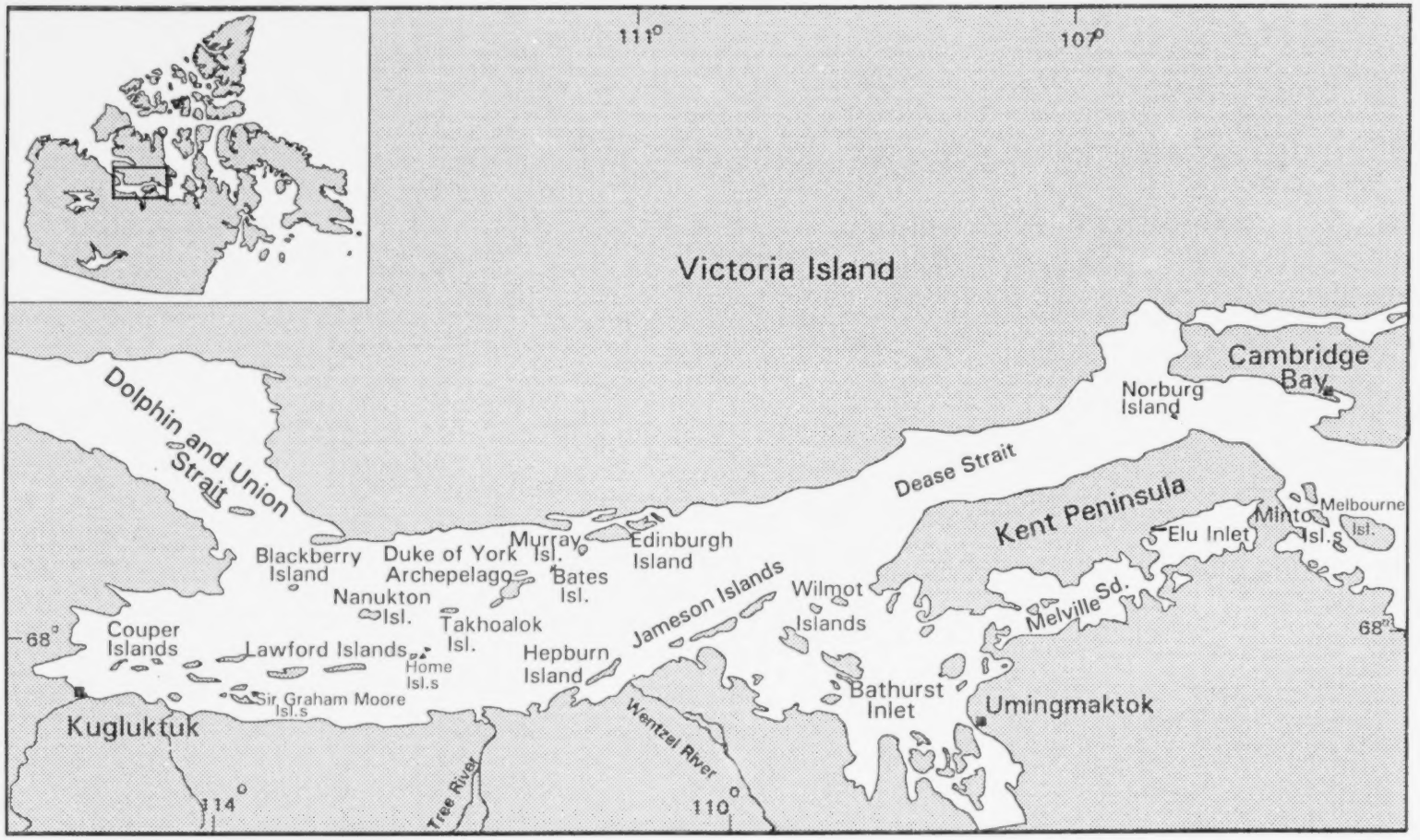

Figure 2. Area surveyed during observations of caribou migrations between Victoria Island and the mainland NWT, April 30- May 18, 1993.

METHODS

We compiled observations of Victoria Island caribou between 1976 and 1986 were from various aerial surveys, snowmachine trips and reports from hunters. In 1989, we recorded caribou sightings and tracks during a ferry flight between Cambridge Bay and Kugluktuk in June and in the spring of 1993, helicopter pilots reported caribou sightings and tracks during the Coronation Gulf Hydrometric Survey.

In March 1993, we were surveying southeast Victoria Island for muskoxen and we added Kent Peninsula when hunters told us that many Victoria Island caribou were using the Peninsula. We flew at 150 m agl altitude and counted the caribou in 750 m strips on either side of the Helio-Courier aircraft.

We had planned a specific survey for describing inter-island movements in 1993 and during that survey, we flew in a Bell 206B helicopter at approximately 60-90m above ground level adjacent to the shoreline, passing directly over points of land, and crossing mouths of small bays. On return trips when observations on the ice would be redundant, we flew about 250 m inland to look for caribou. We either made several passes over tracks and trails to count them, or landed next to them if there was some doubt as to their age and numbers. When caribou were sighted either on land or ashore, we took care not to make multiple passes over them, and instead made a rapid count of them as we flew by. It should be noted that several counts were estimated as 100^{+} where

this number would represent the minimum number of animals present. Fleeting glimpses during a single pass prevented us from consistently classifying by sex and age and whether the caribou were Victoria Island or barren-ground. Multiple passes were only made over caribou from which we were to take pellet samples, and we did this only to establish a good landing area. We used the on-board Global Positioning System to determine track latitude and longitude and the on-board gyro or a hand-held compass to read heading direction.

In 1994, we conducted an aerial transect survey of Melbourne Island on 11 March. The survey was flown in a Helio-Courier, 200m above ground level at 160 kmph with a navigator and two observers. Strip-width was 1000 m on each side of the plane and transects were spaced 2 km m apart. Seven transects were flown over Melbourne Island and a single flight over the Minto Islands. Muskoxen and caribou numbers, on and off transect, were recorded.

RESULTS

By the early 1980s, hunters were reporting about Victoria Island caribou on the islands in Dolphin and Union Strait and the Coronation Gulf (Table 1). We saw Victoria Island caribou on Kent Peninsula in 1985 (Table 1) and a satellite-tracked cow moved to the Jameson Islands for the 1987-88 winter (Gunn and Fournier in prep.). During a fixed-wing ferry flight in early June 1989 (Table 2), we counted 507 tracks and as caribou often tread in each others' tracks, we suggest that at least a few thousand caribou had returned from the mainland to Victoria Island. Further evidence on the size of the migration comes from incidental sightings in March 1993 and from an estimate of 2 544 ± 151 (Standard Error) caribou on Kent Peninsula in March 1993 and (Tables 3 and 4).

In April -May, 1993 we surveyed for caribou and their tracks on the sea-ice. We flew 35.4 hours, including ferry time and search time, during eight days of surveying, (Table 5). We counted 409 caribou groups and from the caribou numbers, tracks and trails, we estimate at least 2580 caribou crossing the sea-ice during the surveys and an additional 4730 concentrated in the area presumedly preparing to cross (feeding and resting). We counted 2076 caribou feeding and 2049 caribou moving (Table 6).

Concentrations of caribou feeding and resting along the mainland coast

Table 1. Victoria Island caribou observed on islands and mainland as evidence for inter-island migration, 1976 - 1986 (A. Gunn, field notes).

1976 March	David Kaomayok reported seeing Victoria Island caribou on the Chapman Islands (mouth of Bathurst Inlet) during an aerial survey for muskoxen.
1982 December	Victoria Island caribou reported on Berens Island (Coronation Gulf) and near Umingmaktok (hunter's report to Roger Binne, Kugluktuk Wildlife Officer).
1985 March	During a polar bear denning survey along the east coast of Victoria Island - 6 Victoria Island caribou were on Jenny Lind Island. Caribou tracks on east Admiralty Island.
1985 May 10-11	Snowmachine trip to Kent Peninsula and Bathurst Inlet, Beechy Point - cow and yearling Victoria Island caribou seen and reports of island caribou at Parry Bay (people preferred to hunt them to make white kamiks). Many caribou visible in Buchan Hills with 20-30 trails on Buchan Bay heading east (barren-ground caribou) Henry Kaomayok said that Victoria Island caribou were on the Chapman Islands during the winter and were hunted in preference to barren-ground caribou as the island caribou were fatter.
1986 March	Polar bear denning survey, east coast Victoria Island - 84 Victoria Island caribou (few large bulls, cows and yearlings) seen on Gateshead Island.
1986 April 15-16	Snowmachine trip to Kent Peninsula and Bathurst Inlet. Two antlerless island caribou crossing on sea-ice toward Cape Colbourne (Victoria Isl.). On Kent Peninsula, groups of 60, 20, 30, 10 mostly cows and yearlings - all barren-ground caribou and reported as fewer caribou than 3-4 weeks earlier. Many trails and tracks crossing Elu Inlet (after 9-11 April storm) and trails crossing Buchan Bay to the east. Philip Kadlun comments that many caribou around Arctic Sound but fewer around Umingmaktok as they had moved east. On Kent Peninsula we classified barren-ground caribou - 265 bulls, 428 cows and 232 yearlings (54 calves:100 cows) - and 3 Victoria Island bulls in a mixed group. Also see another group of bulls of both island and barren-ground types.

Table 2. Summary of caribou sightings and tracks counted during a fixed-wing ferry flight between Cambridge Bay and Kugluktuk over the sea-ice along the Victoria Island south coast, 2 June 1989.

Cambridge Bay, Byron Bay	46 caribou (bulls, juveniles) walking north 317 tracks
Byron Bay - Richardson Isl.	2 dead caribou 108 tracks
Richardson Isl. - Duke of York Archipelago (east)	no tracks
Among Archipelago islands	82 tracks

Table 3. Summary of caribou sightings and tracks reported by helicopter pilots flying the Kugluktuk area as part of the Coronation Gulf Hydrometric Survey as noted by George Fawcett, prior to this study, March 30 - April 25, 1993.

March 30	5-10 caribou sighted 32 km east of Blackberry Island.
March 31	3 caribou sighted at mouth of Tree River walking north.
April 1	10 caribou sighted 8 km west of Blackberry island walking north.
April 8	4 separate trails sighted 11 km north of Blackberry Island walking north.
April 25	10 caribou sighted 19 km northeast of Kugluktuk walking north.
	Also reported numerous tracks along Lawford Island chain coming from the mainland heading north. One particular trail showed extensive use.
	Muskox - reported one lone animal continually sighted on north end of Duke of York Archipelago and is now 'residing' on Bates Island. Another herd of 12 resident on Murray Island to the north.

Table 4. Summary of observation, transect lengths and survey details for estimated Victoria Island caribou numbers, March 1993, Kent Peninsula.

Transect No.	Transect Length (km)	Area (km^2)	Muskoxen On	Muskoxen Off	Caribou On
1	30.5	45.8	7	25	27
2	38.0	57.0	0	0	37
3	27.0	40.5	0	0	21
4	36.0	54.0	0	18	39
5	41.0	61.5	2	0	70
6	39.0	58.5	11	0	67
7	61.5	92.3	3	0	46
8	48.0	72.0	10	0	29
9	56.0	84.0	0	0	35
10	48.5	72.8	0	0	24
11	47.5	71.3	0	0	19
12	41.5	62.3	0	0	70
13	36.0	54.0	0	0	14
14	35.0	52.5	0	0	11
15	55.0	82.5	1	0	24
16	52.0	78.0	0	0	3
17	53.5	80.3	0	0	8
18	30.0	45.0	0	0	0

	Muskoxen	Caribou
Density	0.03	0.47
Population estimate	159.05	2544.73
Standard Error	24.50	151.60
Coefficient of Variation	0.15	0.06

% coverage 21.4
width: 1.5 km
Kent Peninsula area: 5446 km^2
39 possible transects

Table 5. Summary of observed groups of caribou migrating between Victoria and mainland, NWT, 30 April - 18 May, 1993.

Date	Hours Flown	No. of Groups	Mean	SE	Range		No. of Caribou	Tracks
April 30	2.3	1	--	--	--	--	4	14
May 5	3.5	13	28.46*	9.35	3	100**	370	4
May 8	5.5	44	21.05	4.34	1	120	926	9
May 10	3.3	93	15.61	2.07	1	103	1452	0
May 11	7.5	53	21.06	4.56	1	191	1116	4
May 12	2.7	38	10.16	1.31	2	39	396	4
May 13	6.5	112	13.89	1.37	1	71	1556	103
May 18	4.1	55	15.62*	2.78	1	100**	859	393
Total		409					6779	531

* Where group size was estimated, means represent minimum values.

Table 6. Caribou activities observed during helicopter surveys, 30 April - 18 May, 1993.

Date	Activity				
	Moving	Feeding	Resting	Resting/ Feeding	Undeter-mined
April 30	--	4 (4 v)	--	--	--
May 5	363 (55 v)	100*	4	3	--
May 8	605	122 (52 v)	24	--	175
May 10	106	56	209 (3 bg)	286	795
May 11	407	424	100	60	125
May 12	69	118	--	29	180
May 13	177	743	371	50	215
May 18	322	509*	20	--	8
TOTALS*	2049	2076	728	428	1498

* Observed numbers represent minimum estimates of total.
v - identified as Victoria island caribou; bg - identified as barren-ground caribou.

and island shoreline suggest that caribou use these areas to stage and feed intensively before crossing the sea-ice. We suspect that most movement was at night because during an evening snowmachine trip through those areas, we did not see resting caribou. We did not detect a trend in group size throughout the survey period.

We saw caribou moving north in higher numbers from the mainland earlier in the western part of Coronation Gulf than at Kent Peninsula. The highest concentration of moving caribou on the sea-ice occurred on May 8 in the western part of the Gulf when we counted 605 caribou and 9 tracks (Tables 5 and 6). The numbers of moving caribou were still high among the Jameson Island chain by May 11 (Table 6). The greatest movement at Kent Peninsula was on May 18 when we observed 393 tracks and 322 caribou (Tables 5 and 6). This was the highest number of tracks observed during the survey. The tracks were mostly leading off Cape Alexander at the eastern tip and Cape Franklin on the western tip of the Kent Peninsula, while large concentrations of feeding and moving caribou were slightly inland along the coast. Many caribou groups were still observed to be moving in this area after the surveys (Table 7).

Caribou used different crossing strategies depending on ice conditions encountered. Most caribou travelled single file over the ice and on several occasions, were parallelling ice cracks. If the ice was rough, the caribou and tracks were spread out rather than were in single file. We noted that caribou avoided glare, windswept ice and instead travelled along snowdrifts. Freezing

Table 7. Observations during snowmachine trip from Kugluktuk to Cambridge Bay, May 24, 1993.

- 5 young bulls feeding 24 km east of Tree River mouth
- cow/calf pair heading back to Hepburn Island from the ice
- many new tracks offshore Hepburn Island heading north
- 10 caribou moving north up a valley south of Cape Barrow
- 5 caribou heading north, 8 km west of Umingmaktok
- 150 caribou in Buchan Bay travelling north along shoreline (mostly barren-ground but some Victoria Island)
- Scattered groups of 20 caribou moving north among the Hurd Islands in Melville Sound
- 200 caribou in two groups heading north at Warrender Bay, north of Kuururjuak Point
- 30 caribou heading north, Elu Inlet

rain had left a thick (1-2 cm) surface ice layer on Kent Peninsula by May 11 and the snow became more icy as we moved farther east to Melbourne Island.

Caribou were often moving between islands and we noted movements going northwest between the Jameson Island chain and western Kent Peninsula, suggesting that caribou were minimizing sea-ice travel and maximizing foraging before crossing to Victoria Island.

The first survey was on April 30, 1993 and began along the mainland coast of Dolphin and Union Strait approaching the Coronation Gulf (Fig. 3). One group of four Victoria Island caribou was foraging at Bernard Harbour (Fig. 4). The tracks of at least 14 caribou were trudging onto the shore north of Locker Point (Table 5, Fig. 5). Thirteen of these were 5 km north of Locker Point, while the other was 8 km north.

Poor weather halted the survey until May 5 when we flew along the mainland coast east to the mouth of the Wentzel River and then returned following the northern shore of Hepburn island, across the ice to the northern shores of the Home Islands toward Kugluktuk following the Lawford, Sir Graham Moore, and Couper Islands (Fig. 3). Four new tracks were sighted heading west across the mouth of the Asiak River (Fig. 5). Thirteen caribou groups (mean group size of 28.4 ± 9.35 (SE)) had a minimum of 370 caribou (Table 5, Fig. 4).

On May 8, the survey began along Seven Mile Island and continued along the north coast of the Couper chain, arching north to Blackberry Island. After overflying the entire island, the flight continued east through the Duke of York

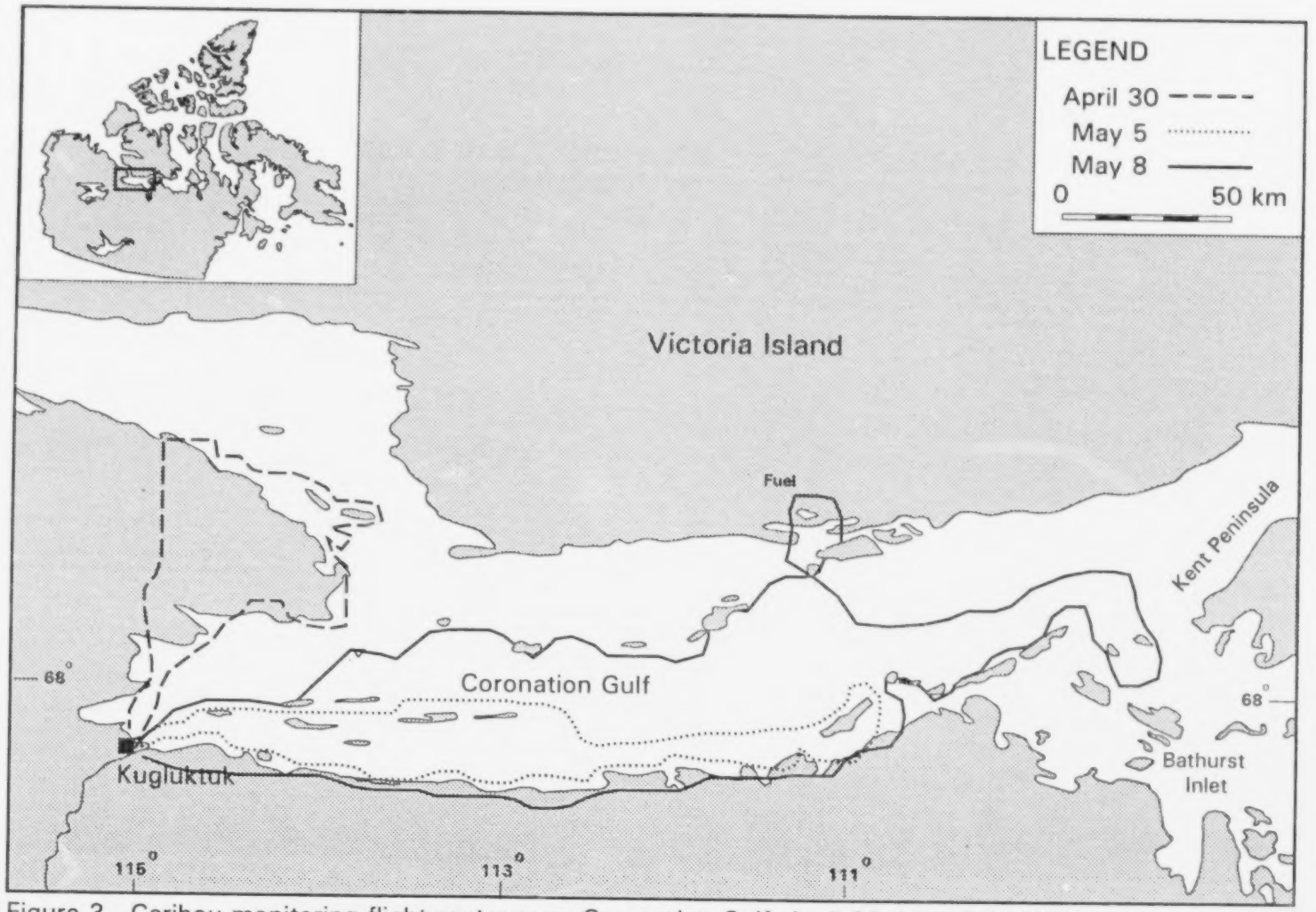

Figure 3. Caribou monitoring flight routes over Coronation Gulf, April 30, May 5,8, 1993.

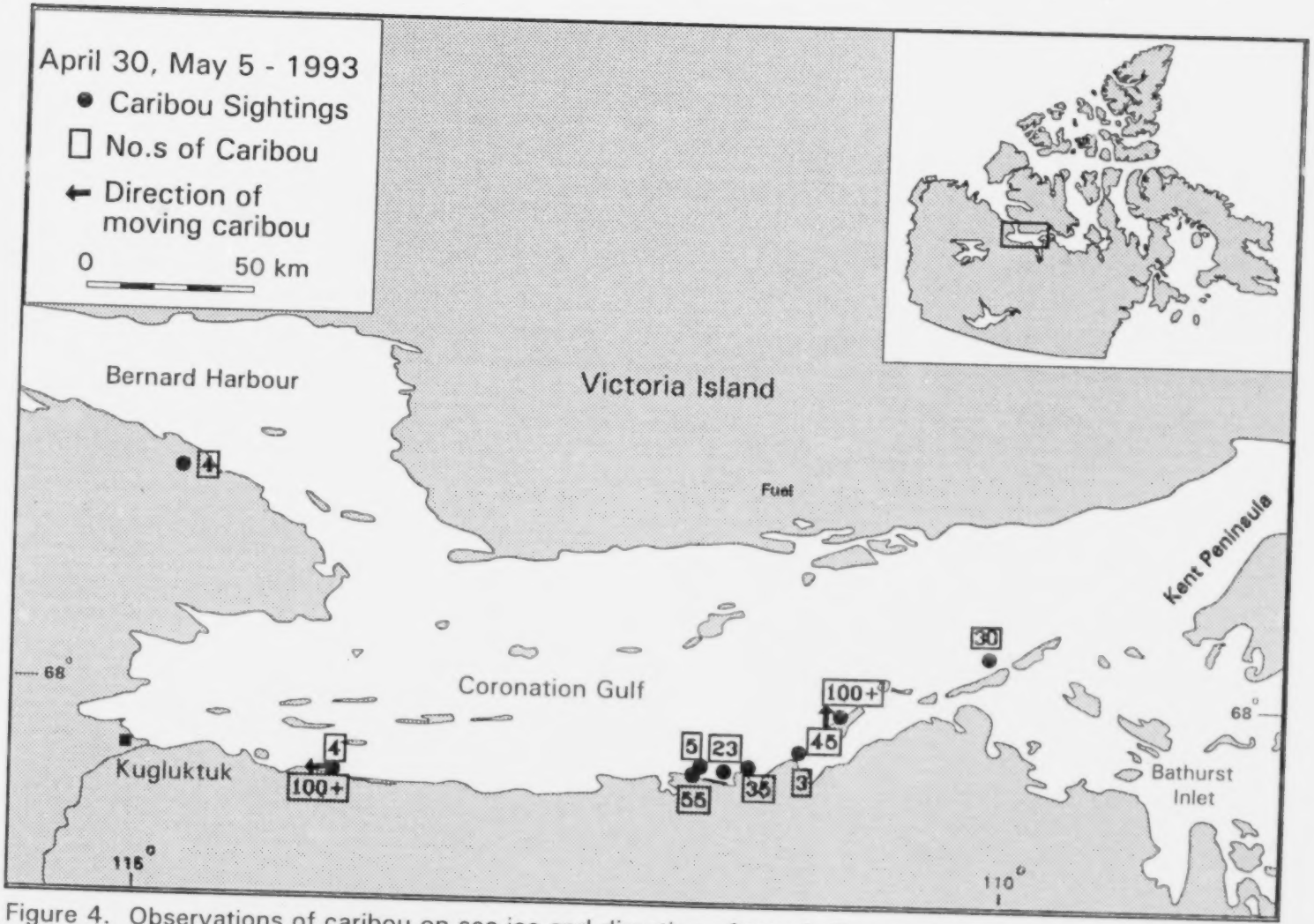

Figure 4. Observations of caribou on sea ice and direction of travel, Bernard Harbour, Coronation Gulf, April 30 and May 5, 1993.

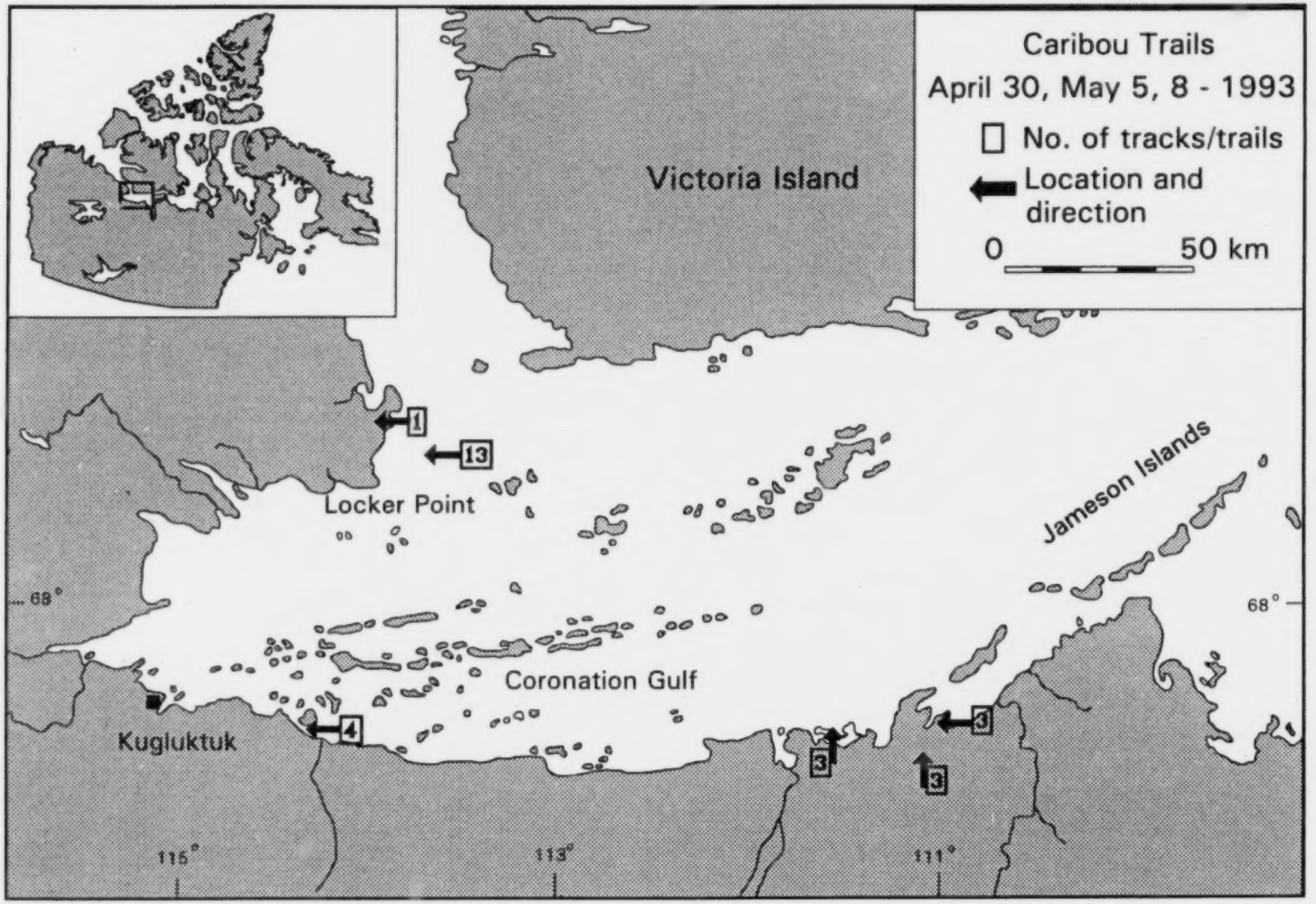

Figure 5. Location and direction of caribou trails in the western end of the Coronation Gulf, April 30, May 5,8, 1993.

chain. We then flew across the gulf to the mid-point of the Jameson Islands, following their northern coasts, then turning south to the Wilmot islands (Fig. 3). We counted 926 caribou in 44 caribou groups (mean group size 21.1 ± 4.34) (Table 5, Fig. 6). The nine tracks were heading north in the vicinity of Port Epworth (Fig. 5).

The survey originating from Cambridge Bay on May 10, began through the Duke of York island chain east to the Couper chain and then followed the coast and moved up the shoreline of Kent Peninsula (Fig. 7). We counted 1452 caribou in 93 groups (15.6 ± 2.07) (Table 5, Fig. 8). Most groups were resting or feeding along the Kent Peninsula coast.

The May 11 flight began along Kent Peninsula and the coastline to Kugluktuk and return (Fig. 7). We counted 1116 caribou in 53 groups (21.1 ± 4.56) (Table 5, Fig. 9). Four tracks were heading north off the Jameson Islands (Fig. 10).

On May 12, we flew from Cambridge Bay south to Cape Alexander, toward Trap Point and Minto and Melbourne islands. We proceeded back onto the mainland shore of Labyrinth Bay and up to Cape Alexander (Fig. 11). We counted 396 caribou in 38 groups (10.2 ± 1.31) (Table 5, Fig. 9). Four old tracks were heading west onto Nunaritgak Island at Trap Point (Fig.10).

On May 13, the survey flight went from Cape Alexander, along the shore of Kent Peninsula, offshore to the Wilmot islands, down through the Jameson Island chain and returned east (Fig. 11). Many caribou were travelling on the ice

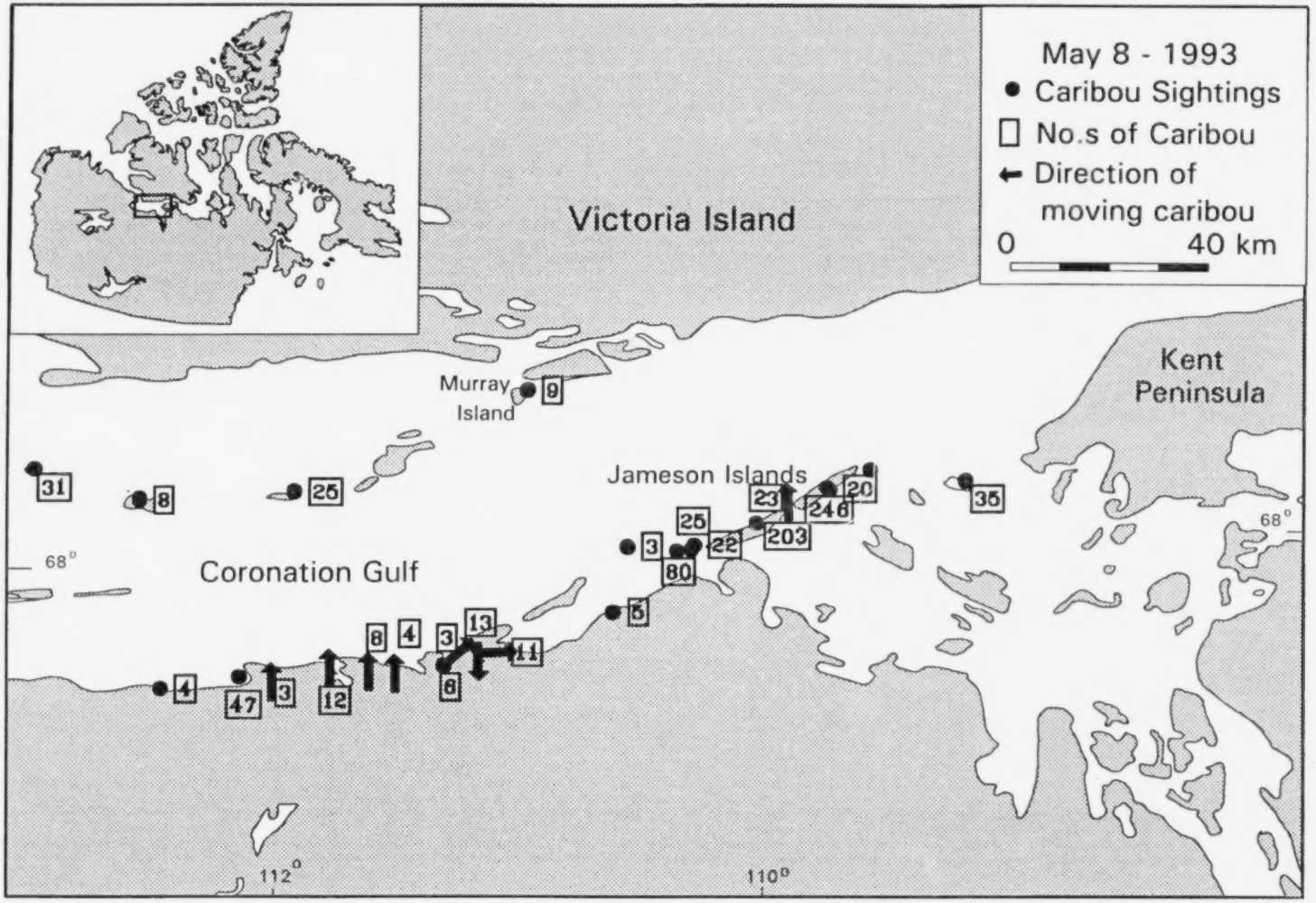

Figure 6. Observations of caribou on sea ice and direction of travel, Coronation Gulf, May 8, 1993.

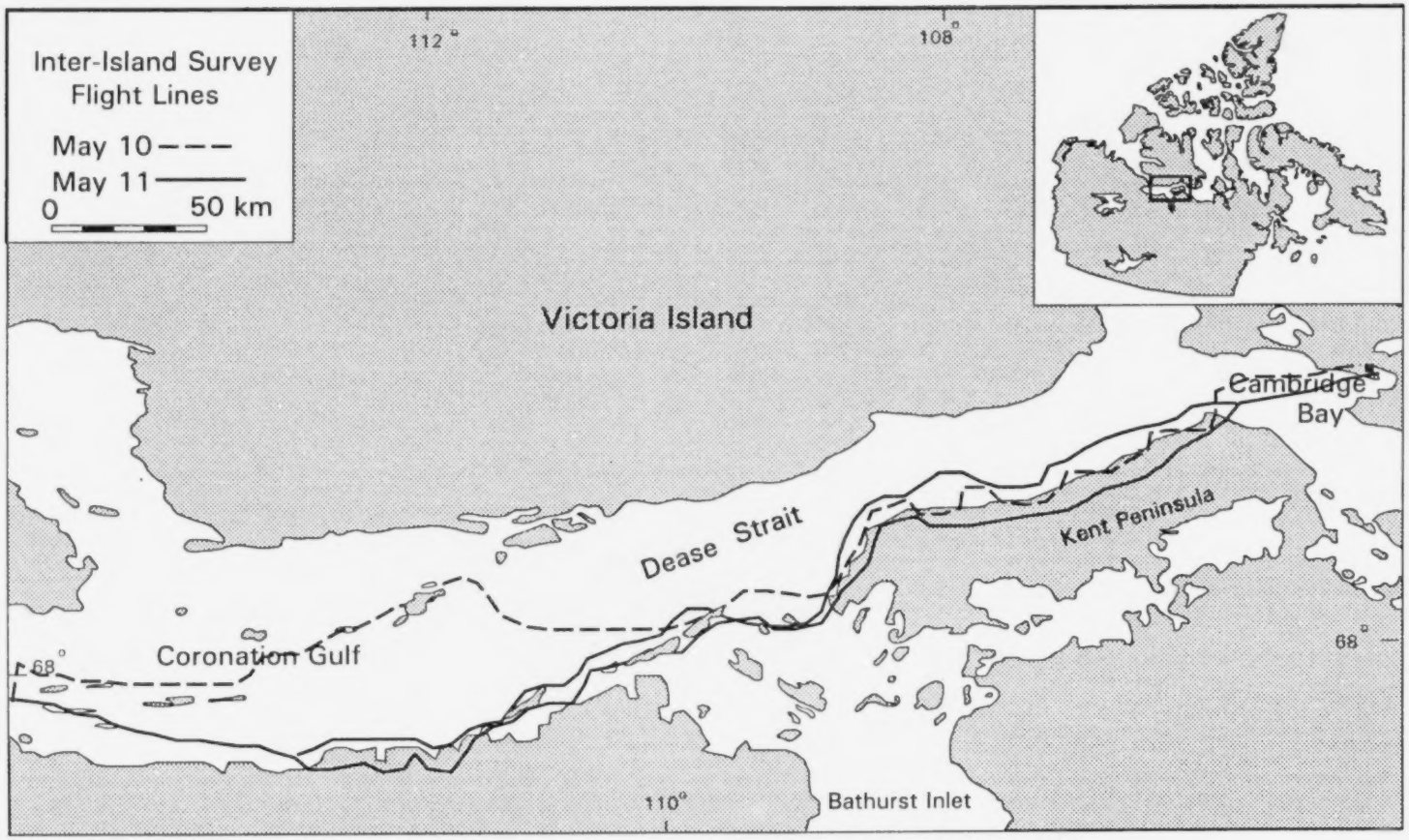

Figure 7. Caribou monitoring flight routes over Coronation Gulf, May 10-11, 1993.

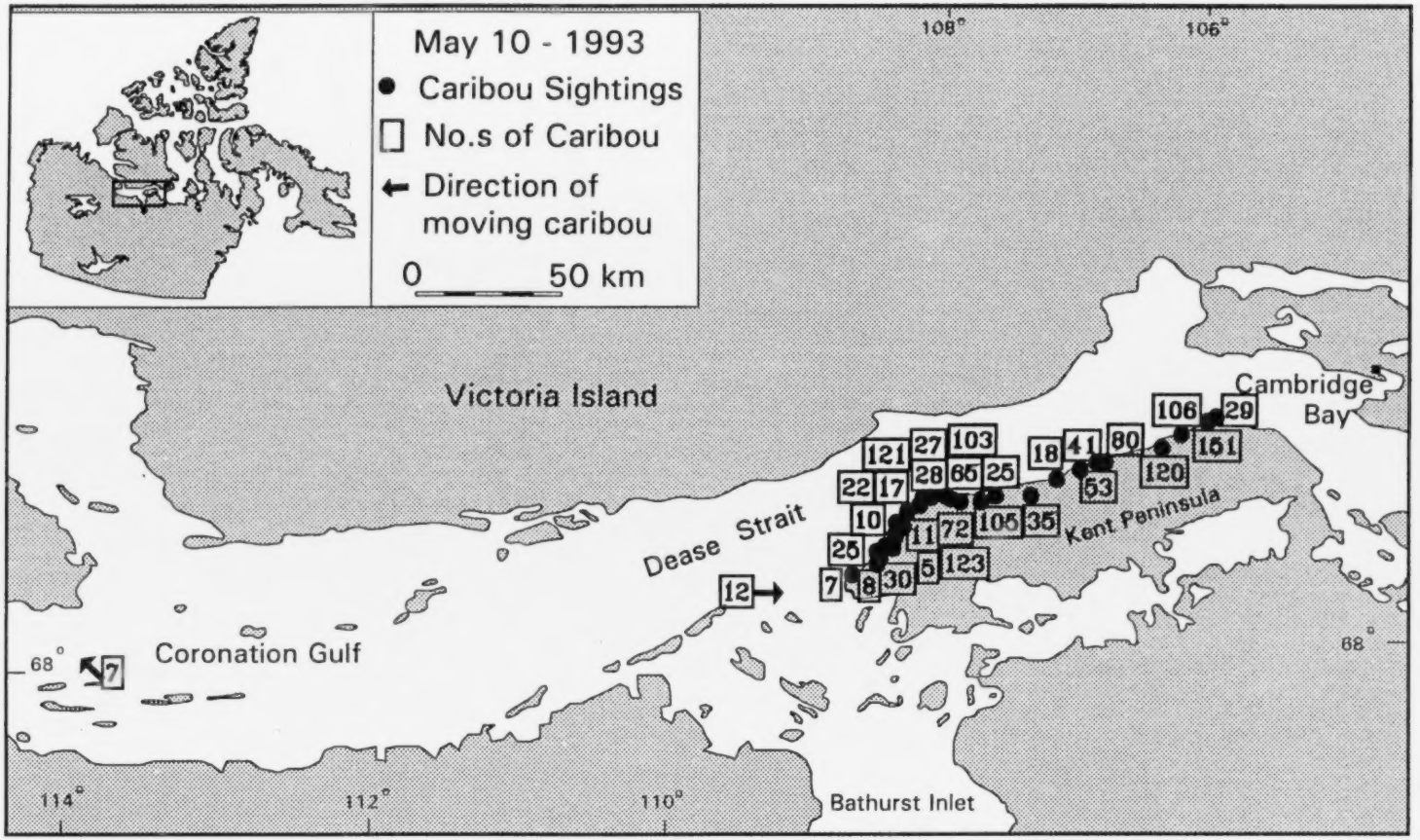

Figure 8. Observations of caribou on sea ice and direction of travel, Kent Peninsula and Couper Islands, May 10, 1993.

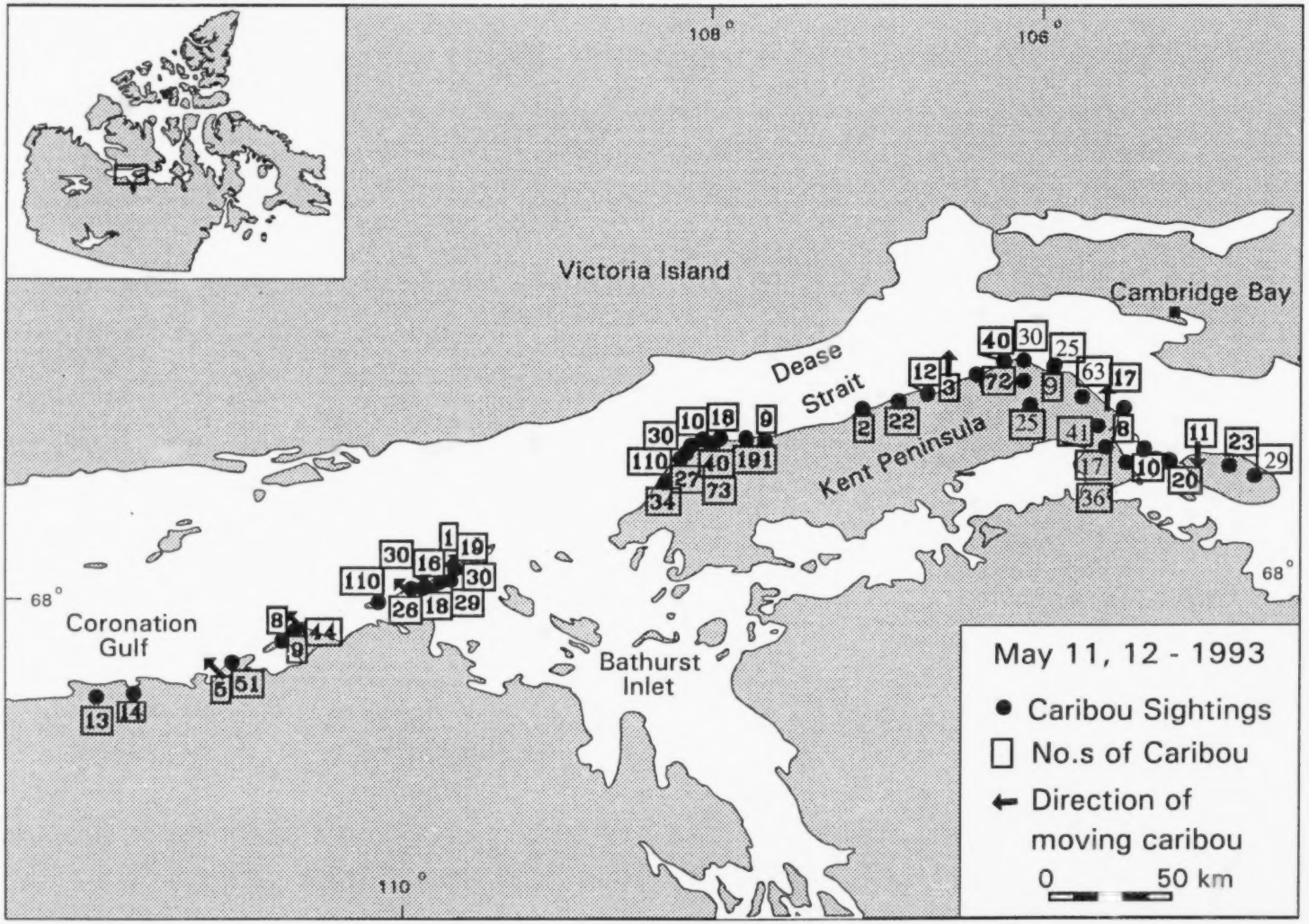

Figure 9. Observations of caribou on sea ice and directon of travel, Coronation Gulf and Dease Strait, May 11-12, 1993.

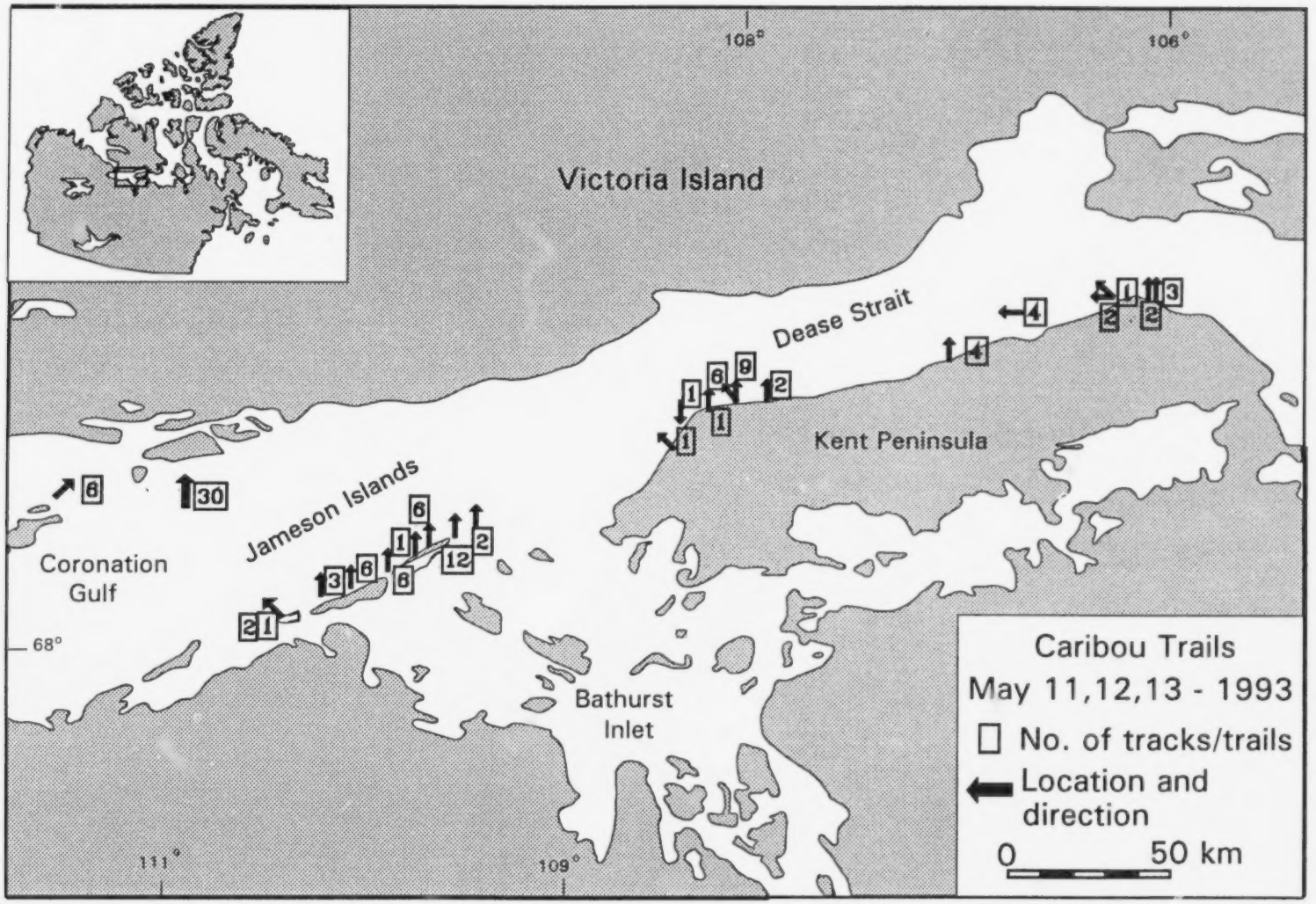

Figure 10. Location and direction of caribou trails on the sea ice on the Coronation Gulf and Dease Strait, May 11-13, 1993.

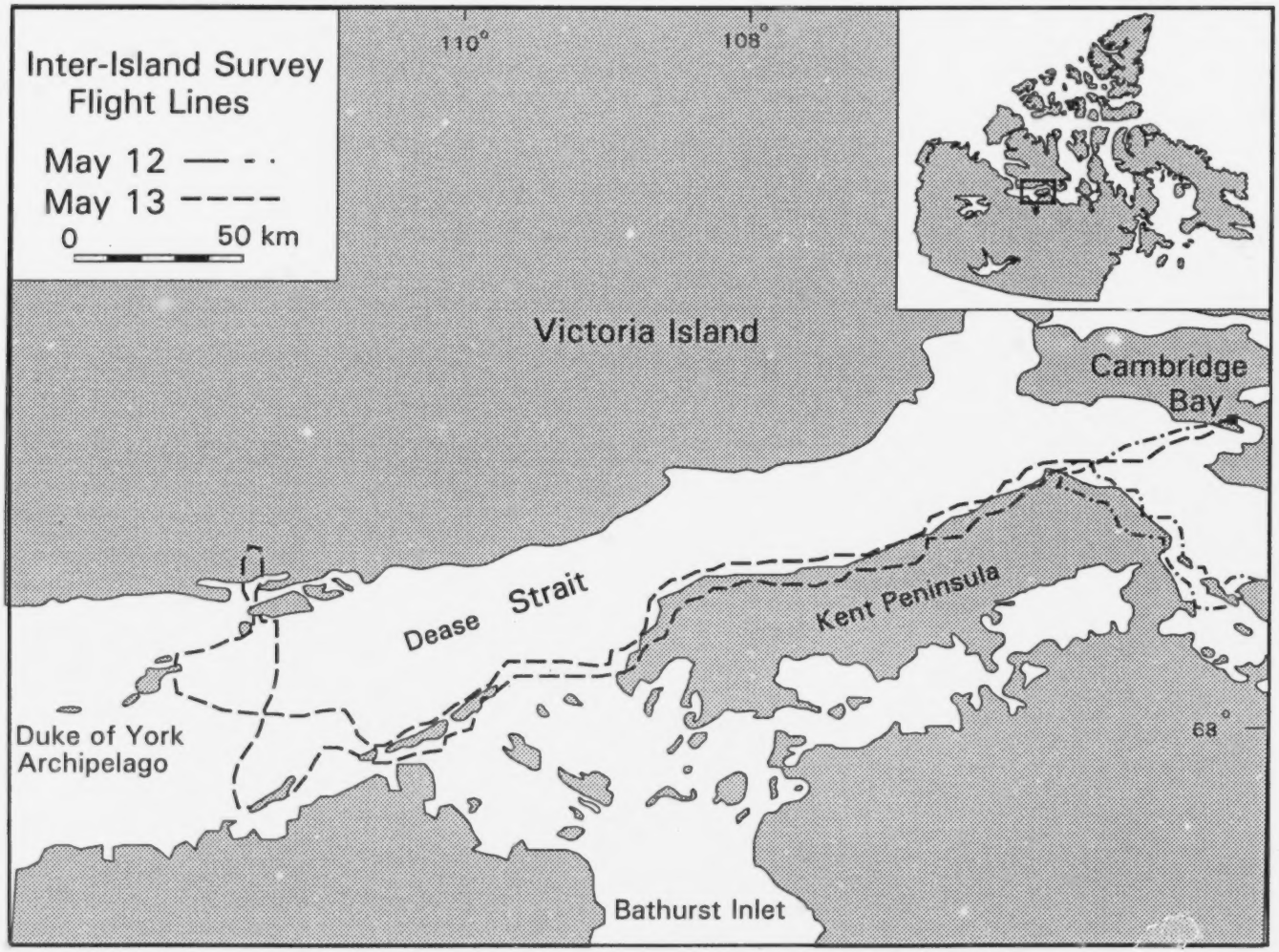

Figure 11. Caribou monitoring flight routes over Dease Strait, May 12-13 1993.

during this survey and good visibility allowed us to count 103 caribou heading north (Fig. 10). We saw 1556 caribou in 112 groups (13.9 ± 1.37) (Table 5, Fig. 12). A group of 24 caribou was resting on the ice 24 km from shore in mid-gulf.

The final survey on May 18 approached Cape Alexander and moved down the shore of Kent Peninsula to the end of the Jameson Island chain (Fig. 13). We counted 859 caribou in 55 groups (15.6 ± 2.78) (Table 5, Fig. 14). The highest number of caribou trails and tracks (393) was encountered on this survey (Fig. 15). Eighteen cow/calf groups were on the Jameson Island chain along with 10 other groups ranging in size from 1 to 54 caribou. Most groups were observed feeding.

During the 1993 survey, we counted 184 muskoxen. Five was the largest number of groups observed on May 13, with a mean group size of 16.4 ± 6.71 and 82 muskoxen were on Kent Peninsula (Table 8, Fig. 16).

During the 11 March 1994 survey of Melbourne Island, observers counted 344 caribou on transect and estimated a population of 719 ± 83 (Fig. 17, Table 9); an additional 62 caribou were observed on the Minto Islands. Caribou on Melbourne Island were predominantly Victoria Island caribou. Observers also counted 22 and 85 muskoxen, on and off transect respectively, for an estimate of 46 ± 25 (Table 10). Due to the clumped distribution of muskoxen on Melbourne Island, the coefficient of variation was high (CV = 0.54).

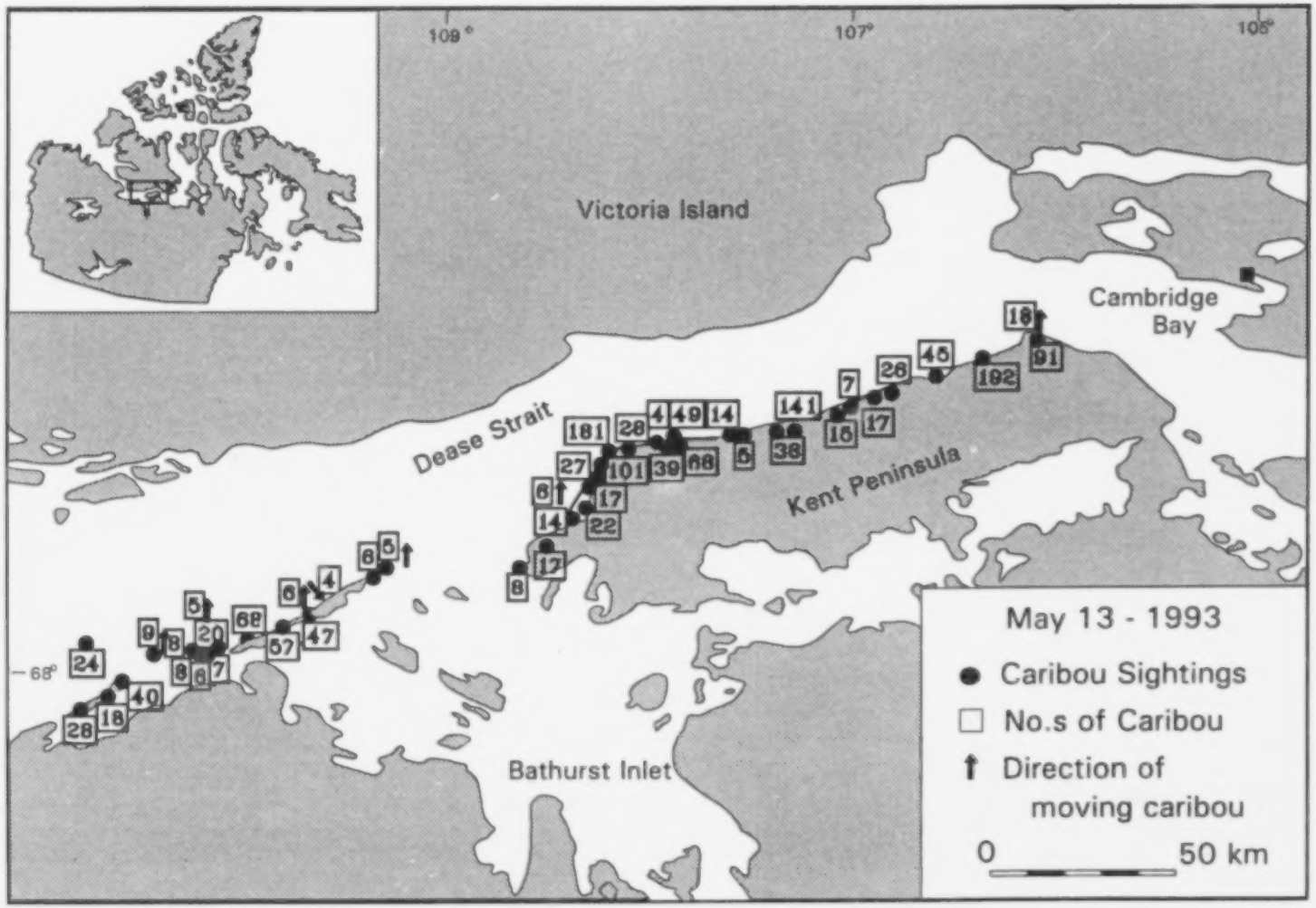

Figure 12. Observations of caribou on sea ice and direction of travel, Dease Strait, May 13, 1993.

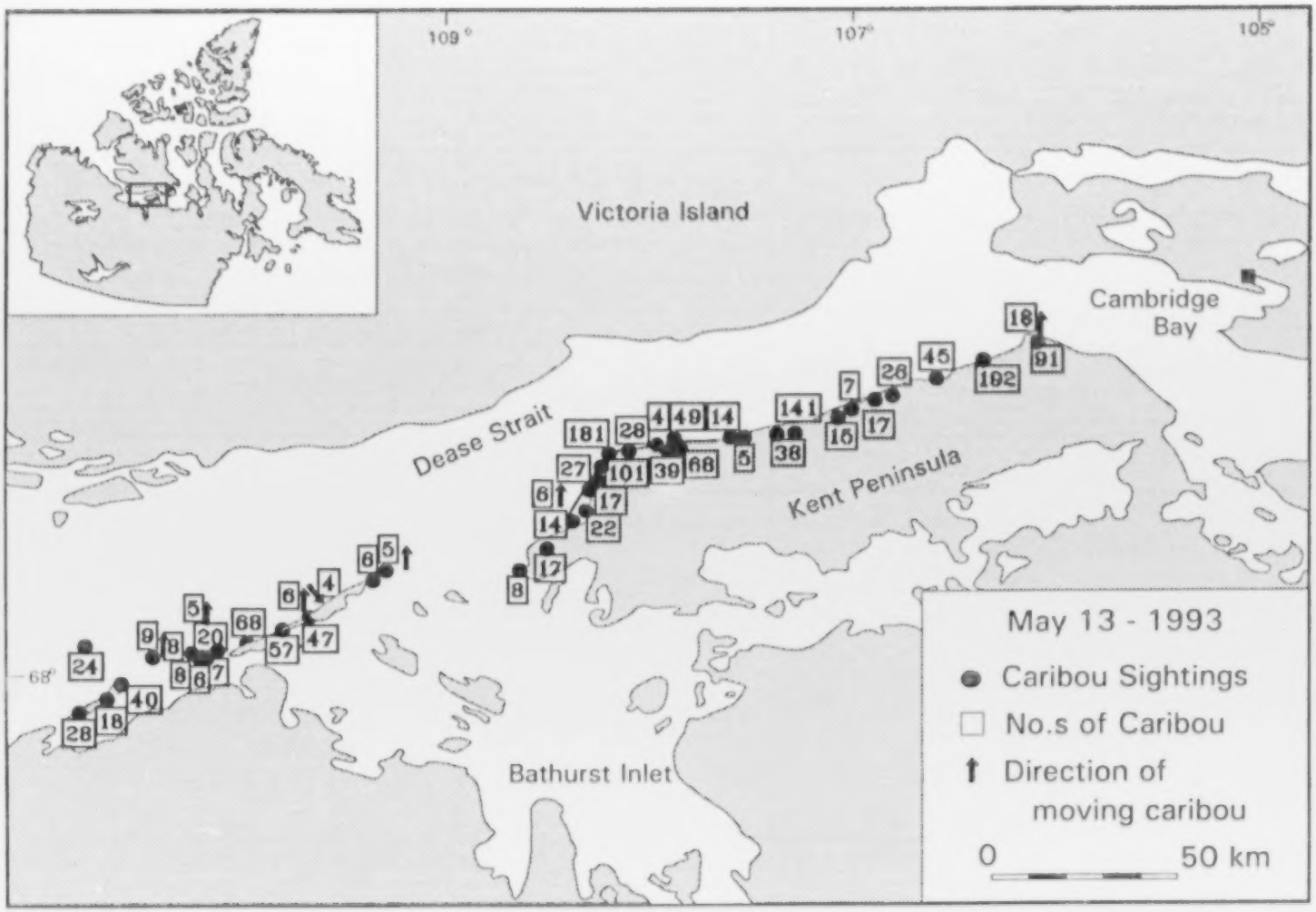

Figure 12. Observations of caribou on sea ice and direction of travel, Dease Strait, May 13, 1993.

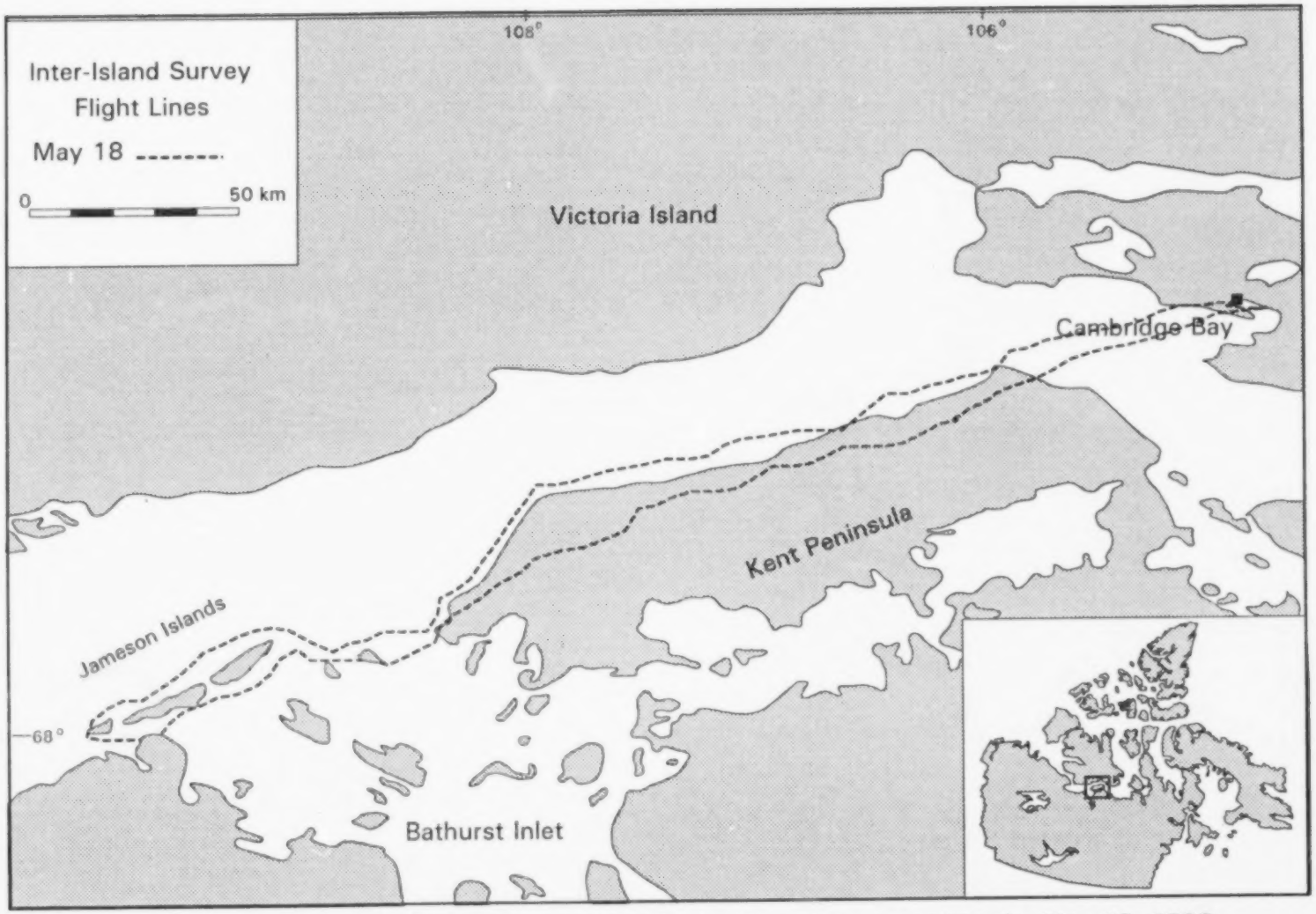

Figure 13. Caribou monitoring flight routes over Kent Peninsula and Jameson Islands, May 18, 1993.

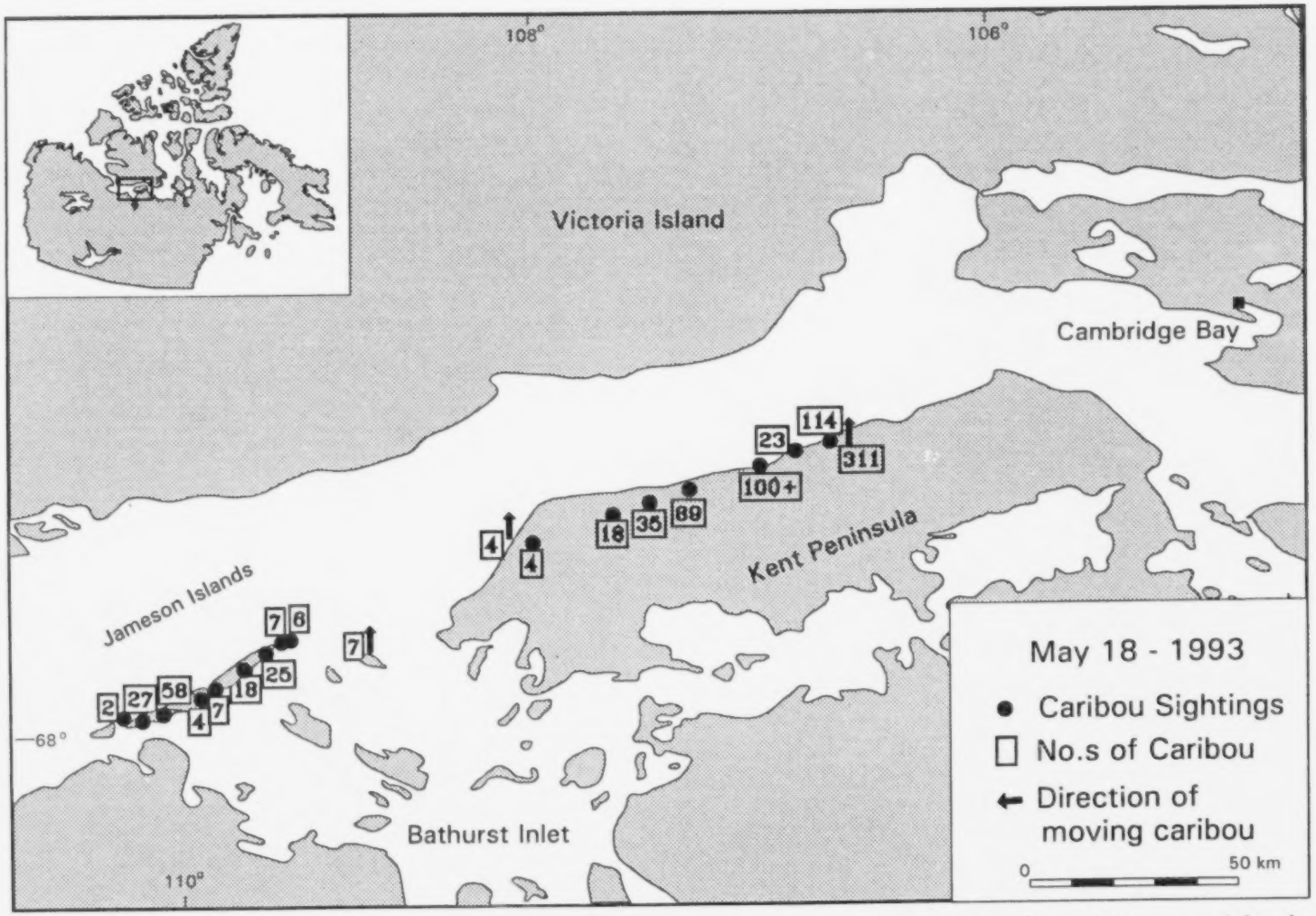

Figure 14. Observations of caribou on sea ice and direction of travel, Kent Peninsula and Jameson Islands, May 18, 1993.

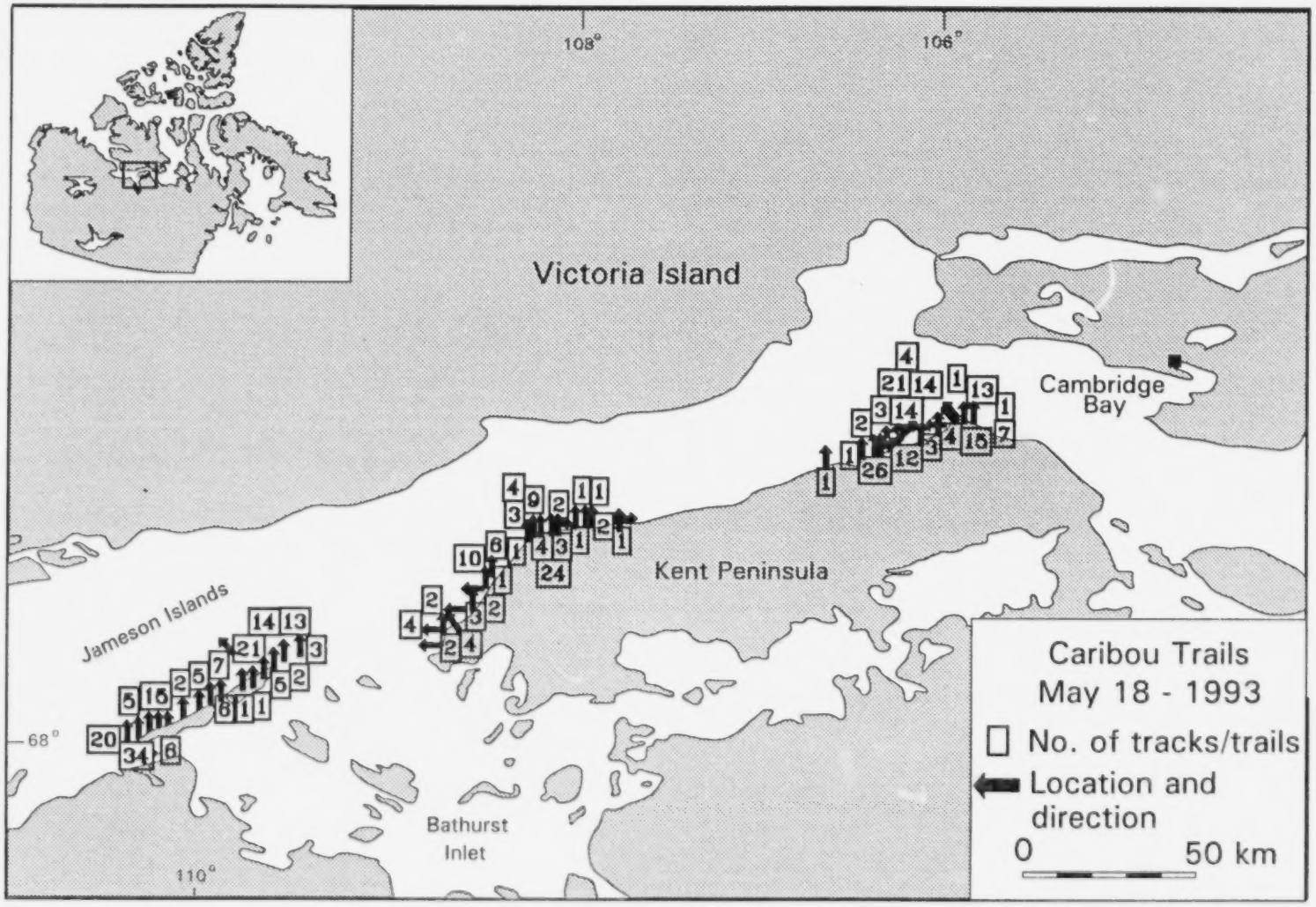

Figure 15. Location and direction of caribou trails on the western end ofthe Coronation Gulf, May 18, 1993.

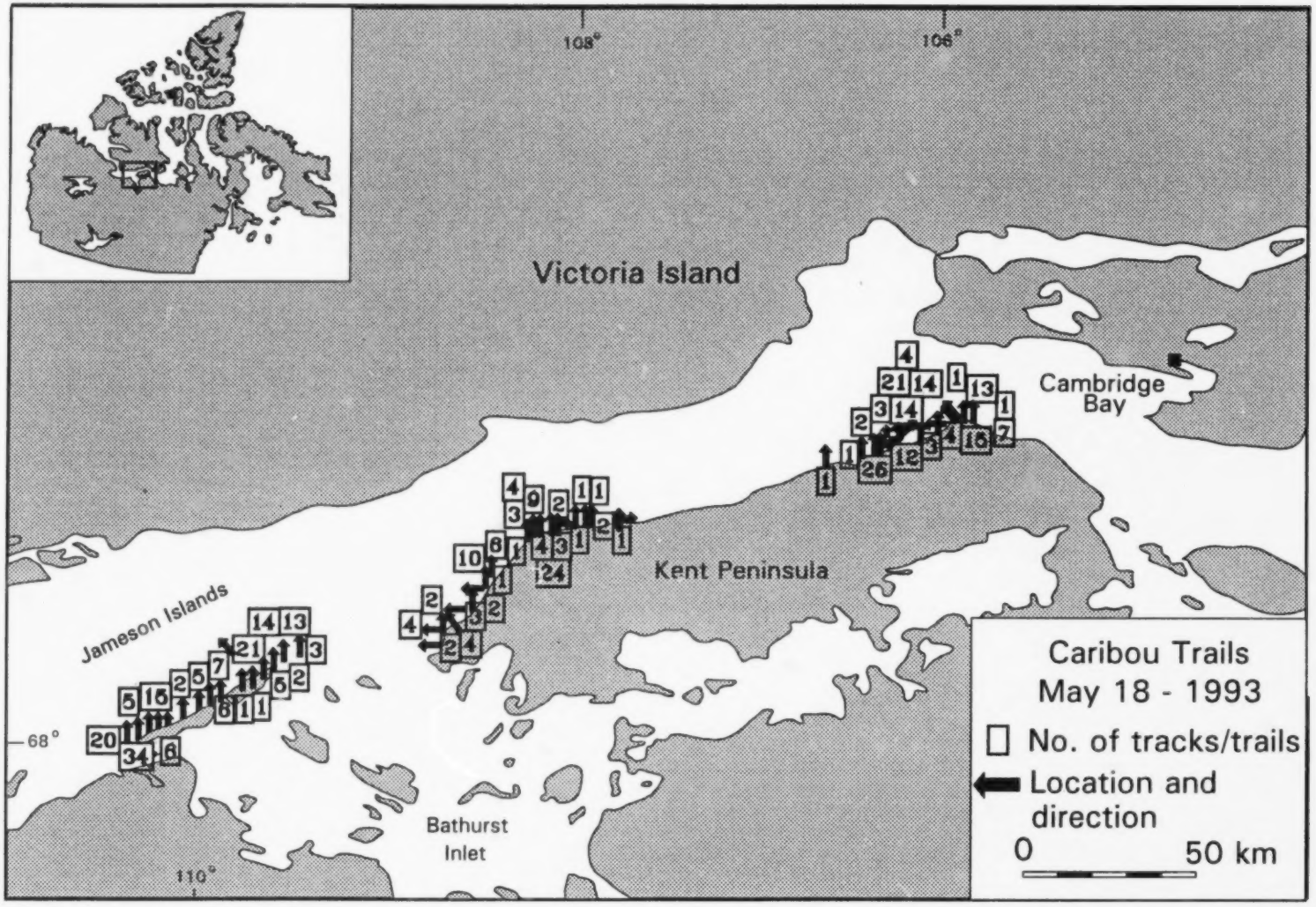

Figure 15. Location and direction of caribou trails on the western end othe Coronation Gulf, May 18, 1993.

Table 8. Muskox herds in the Coronation Gulf region, April 30 - May 18, 1993.

Date	No. of Groups	Mean Group Size	S.E.	Range		Totals
April 30	1	10.0	--			10
May 8	2	19.0	--	10	28	38
May 10	1	20.0	--			20
May 12	3	3.3	1.33	2	6	10
May 13	5	16.4	6.71	4	41	82
May 18	2	12.0	--	4	20	24
Total	14					184

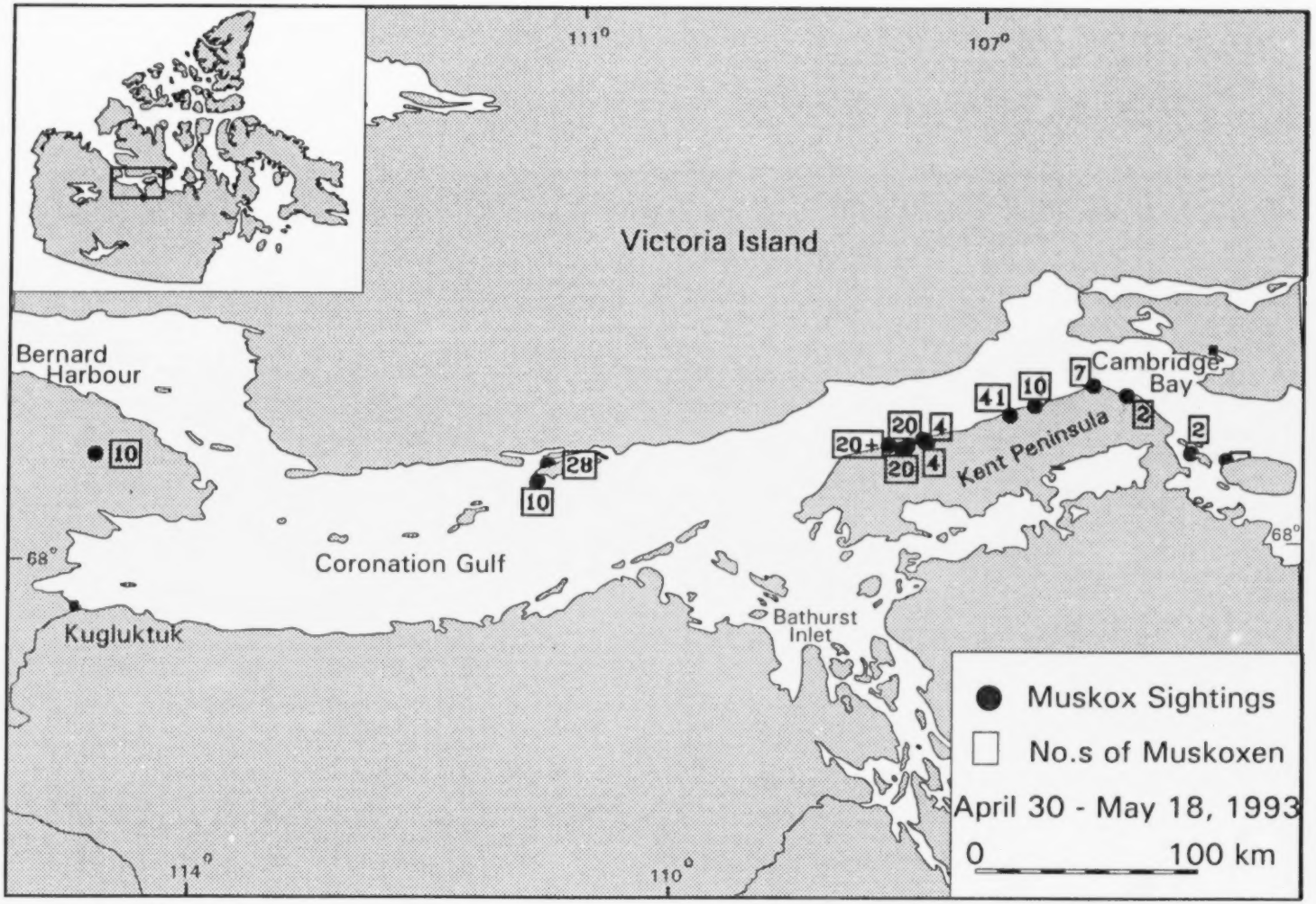

Figure 16. Obervations of muskox on the Coronation Gulf region, April 30 - May 18, 1993.

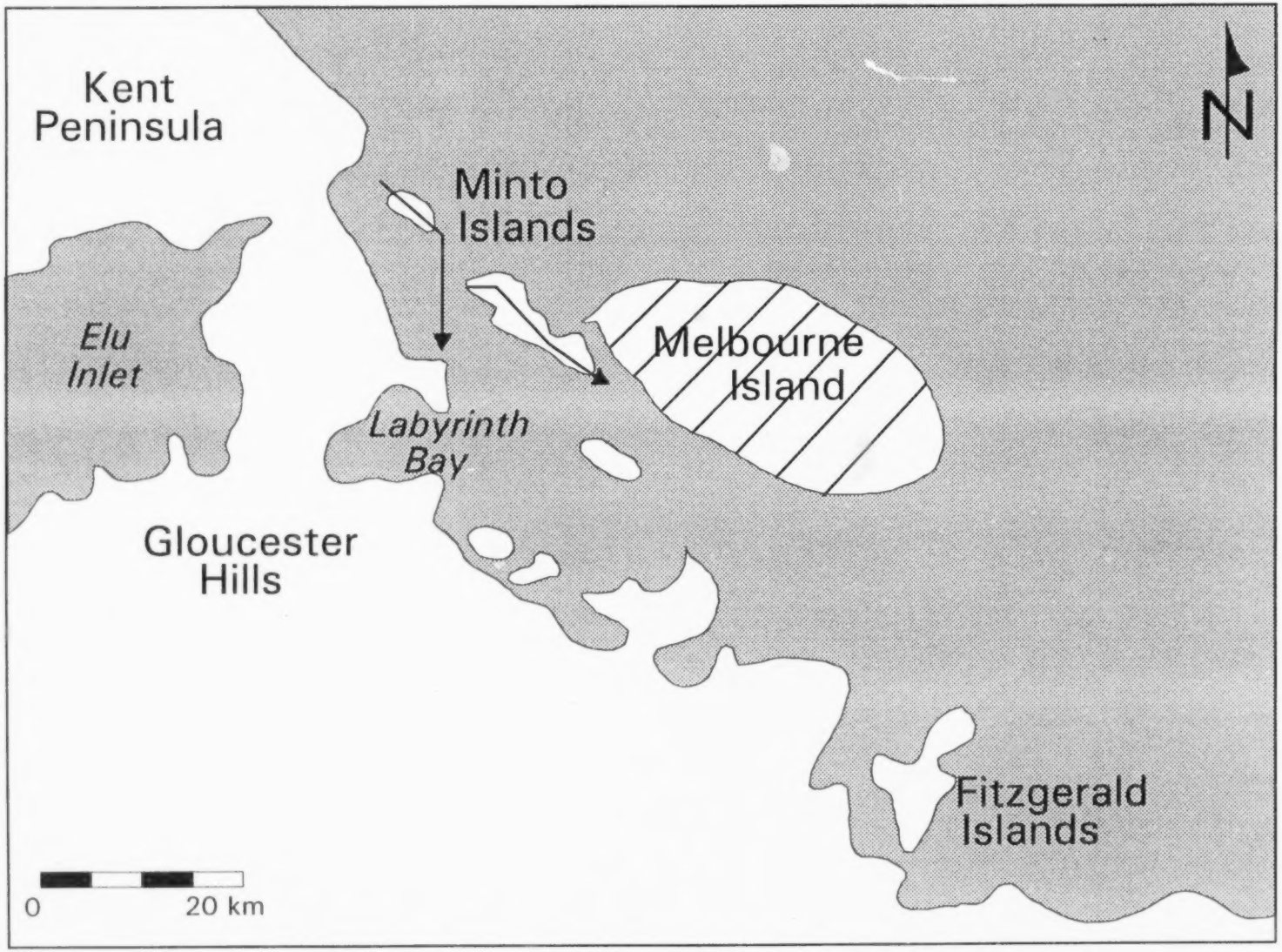

Figure 17. Reconnaissance flight lines and transect lines on Minto and Melbourne Islands, Northwest Territories, March 1994.

Table 9. Analysis of data from an aerial survey of Victoria Island caribou on Melbourne Island, 11 March 1994.

Maximum number of transects (N)	15
Number of transects surveyed (n)	7
Stratum area, km^2 (Z)	386.5
Transect area, km^2 (z)	185.0
Number of caribou counted (y)	344
Caribou density (caribou / km^2) (R)	1.86
Population estimate (Y)	719
Population variance (Var Y)	6 815
Standard error (SE)	83
Coefficient of variation (CV)	0.146
95% CI	202
% Coverage	47.9

Table 10. Analysis of data from an aerial survey of muskoxen on Melbourne Island, 11 March 1994.

Maximum number of transects (N)	15
Number of transects surveyed (n)	7
Stratum area, km^2 (Z)	386.5
Transect area, km^2 (z)	185.0
Number of muskoxen counted (y)	22
Muskox density (muskox / km^2) (R)	0.119
Population estimate (Y)	46
Population variance (Var Y)	606
Standard error (SE)	25
Coefficient of variation (CV)	0.543
95% CI	60
% Coverage	47.9

However, we are confident that we observed all muskoxen on Melbourne Island, either on or off transect, and provide a total count of 116. In addition, we observed 30 animals on the Minto Islands for a total of 146 muskoxen on the Minto-Melbourne Island archipelago.

DISCUSSION

The Victoria Island caribou's annual migration between the coastal mainland and Victoria Island began again in at least the 1970s and has subsequently increased until, by 1993, thousands of caribou were migrating. Our documentation that over 7000 caribou had or were crossing in May 1993 was one of our objectives for this study.

Our observations suggests that the spring migration of the caribou to Victoria Island starts possibly in April and continues to June. In 1993, most of the caribou seen in May were cows, yearlings and a few young bulls. Those results fit with our observations in June 1989 when we saw bulls and juveniles. Cows and yearlings usually precede bulls in caribou spring migration.

Our other objective was to determine areas of concentrations of trails crossing the sea-ice between the south coast of Victoria Island and the mainland. Track distribution suggests caribou were 'island-hopping' whenever possible although we cannot deduce from our data to what extent caribou would deviate to make the shortest possible ice-crossing. Clearly the islands and Kent Peninsula were areas of concentrated crossing activity. Further work is needed to confirm our suggestion that peak migration in the west preceded the migration in the east (from Kent Peninsula) and to determine to what extent the timing reflects how far south caribou are distributed from the mainland coast. Further work is also needed to verify how snow conditions affect migration. We saw the

greatest movements on Kent Peninsula after the snow on the land had become icy from freezing rain.

The high numbers of caribou on the islands may be caribou concentrating as they feed and rest in preparation for crossing rather than island-hopping. Kelsall (1968) described caribou moving in waves across large frozen lakes and Bathurst Inlet . Kelsall (1968) commented that caribou did not take the shortest possible routes but oriented to their line of general movement and crossings appeared to be independent of wind direction (except very strong winds).

Our results contribute to describing the extent to which Victoria Island caribou are within the reach of hunters from two communities (Kugluktuk and Umingmaktok). When COSEWIC classified Victoria Island caribou as "threatened", the reasoning was partly because the harvest was high compared to estimated population size. The greater access to Victoria Island caribou that wintered on the mainland serves to highlight that original concern.

Secondly, our results contribute to predict the effects and develop mitigation measures for marine transportation developments including a port at Kugluktuk and ore-carriers along the Dolphin and Union Strait and the Coronation Gulf (NPCTT 1996). Our survey timing precedes the proposed ship's passages which are planned for late June, but we have documented the scale of the movement for May and our observations that the prime bulls had not started their migration. The bulls' June migration and the extent to which the cows' annual migration varies in timing are issues that will need follow-up especially

considering predictions for global warming which include an earlier break-up and a later freeze-up for sea-ice.

Surveys and radio-tracking have to extend over a long period of time to determine the timing of migrations which is a key question in planning for the passage of ice-breakers and other vessels. Satellite telemetry would provide more continuous coverage depending on the frequency of transmission (duty cycle).

Victoria Island caribou have largely replaced the barren-ground caribou wintering on Kent Peninsula. This forces hunters with commercial tags for the Cambridge Bay meat plant to travel further as the quotas are assigned to the Bathurst herd of barren-ground caribou and not Victoria Island caribou.

Our hypothesis for why Victoria Island caribou are migrating to the mainland is that snow conditions and forage availability are more variable on the mainland because of its varied topography and more abundant vegetation. Miller *et al.* (1982) demonstrated that seasonal migrations between arctic islands were responses to changes in forage availability brought about by snow depths and springtime icing. Snow conditions may magnify any difference in forage availability caused by the caribou themselves. Although caribou affecting their winter forage has not been demonstrated, it is possible or even likely: Victoria Island caribou forage along raised beaches and uplands where the amount of plant material (biomass) is relatively low. On Baffin Island, Inuit elders believe that the shifts in winter range are due to caribou moving in search of forage after

having used up the forage in one area (M. Ferguson pers. comm.).

Hunters' reports and our information point to a progressive shift in winter distribution to the south and east on southern Victoria Island during the 1980s. The Victoria Island caribou have replaced the barren-ground caribou that previously wintered on the Kent Peninsula and south of Elu Inlet toward Umingmaktok and which most likely are from the Queen Maud Gulf herd (Gunn, Nishi and Dragon in prep.). The appearance of Victoria Island caribou and disappearance of barren-ground caribou from the Kent Peninsula and vicinity may be related or coincidental. The physically smaller Victoria Island caribou are unlikely to displace barren-ground caribou which suggests the appearance and disappearance are coincidental. If the barren-ground caribou shifted their range as they reduced the available forage, this would not necessarily put the Victoria Island caribou at a disadvantage. Even relatively small changes in incisor arcade confer foraging advantages (Illius *et al.* 1995). We know that Victoria Island and barren-ground caribou differ in the proportions of their skulls including molar tooth row length (Gunn and Fournier 1996) although we have no comparable measures of incisor arcade for barren-ground caribou. Comparing the foraging capability of the two caribou types should not be restricted to tooth row size and shape - Staaland *et al.* (in press) noted that Victoria Island caribou have larger hind guts and omasa than Norwegian reindeer although they caution that the relationship between structure and function may be limited.

Until we do the experiments needed to assign causality to foraging

dynamics, we will be always describing and not predicting ecological changes such as the changes in winter distribution that we have described in this report. Given the changes inherent in global warming, and without having the experimental basis to predict the relationships between weather, forage plants and caribou (*sensu* Caughley), we may be too late for ameliorative management. That may be the prescription for caribou declines.

RECOMMENDATIONS

1) Measures should be taken to reduce the commercial harvest of Victoria Island that migrate to the mainland.

- Melbourne and Minto Islands, in addition to Kent Peninsula should be removed from Wildlife Management Zone (WMZ) F/2 and included in WMZ B/2 to stop commercial harvesting of Victoria Island caribou in those areas during winter and early spring.
- Commercial caribou harvesters should be encouraged to travel further south on the mainland to hunt barren-ground caribou.

2) To prescribe mitigative measures for ship traffic, future studies should describe between year variability in timing of the spring and fall migrations. Specifically, research should describe the changes in number and sex/age composition of caribou undertaking these seasonal movements and test for correlation with environmental cues (*i.e.*, snow depth, and rate of freezing and melting of sea ice).

3) Melbourne and Minto Islands should be included in a Muskox Management zone so that hunters have the opportunity to harvest muskoxen on those islands.

ACKNOWLEDGEMENTS

We respectfully acknowledge our debt to David Kaomayok whose acute ecological knowledge and patient teaching underpins much of what we have written. We thank George Fawcett for providing letters and information on caribou sightings; Judy Dragon, Mika Sutherland and Stephanie Papik for editing; Josh Hunter, Isaac Klengenberg, David Kaomayok, George Angohiatok, and Dave Epilon for assisting during the surveys.

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D. Kaomayok, hunter, Cambridge Bay, NT

H. Kamayoak, hunter, Umingmaktok, NT

P. Kadlun, hunter, Umingmaktok, NT

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APPENDIX A Summary of weather conditions during observations of caribou migrations in the Coronation Gulf region, April 30 - May 18, 1993.

Date	Region	Weather Conditions	Light Conditions
April 30	Coronation Gulf	clear	visibility > 24 km
May 1-4	Kugluktuk	overcast	poor
May 5	Kugluktuk	600' ceiling	visibility 10 km
May 8	Coronation Gulf	high scattered cloud eastern cloud front	poor
	Wilmot Islands	overcast	poor
May 10	Kugluktuk	scattered 600' ceiling	excellent
	Coronation Gulf	clouds from the east	fair
	Cape Alexander	close to whiteout conditions	
May 11	Kent Peninsula	clear	excellent
May 12	SW of Cambridge Bay	low clouds, thinning int the afternoon	fair
May 13	Cambridge Bay	scattered, 900' ceiling	excellent
	West of Jameson Islands	low bank of cloud/fog	
May 14	Kugluktuk		variable
May 18	Cambridge Bay	broken 10 000' ceiling broken 2000' ceiling	visibility 16 km

APPENDIX B. Caribou and muskox observations in the Coronation Gulf region, April 30 - May 18, 1993.

Summary of Observations Inter-Island Survey

We flew at approximately 200-300ft A.S.L. adjacent to the shoreline, passing directly over points of land, and crossing mouths of small bays. On return trips when ice observations would be redundant, we flew 1/4 mile inland to observe caribou readying themselves for the crossing.

Upon finding tracks/trails, we either made several passes over them to better count them, or landed next to them if there was some doubt as to their age/numbers. When caribou were sighted either on land or ashore, we took care not to make multiple passes over them, and instead made rapid count of them as we flew by. Multiple passes were only made over caribou from which we were to take pellet samples, and we did this only to establish a good landing area. Location of the track/trail was established by the use of an on-board G.P.S. which gave fixes in Degrees/Minutes/Decimal Minutes. Heading was established by use of the on-board compass or hand compass.

On April 30, we began the survey by flying the western approach to Coronation Gulf. Josh Hunter, Issac Klengenberg and myself flew this day. Weather was excellent, with no cloud cover, high temperatures, and visibility more than 15 miles. We began counting track/trails after passing north of Cape Hearne. This being so, we did observe 2 separate fresh trails of caribou heading west south of Cape Kendall. One trail consisted of at least 4 individuals, all adult. The second trail consisted of a cow/calf. Once we began noting tracks, we made observations 1-4. The flight lasted 2 hours and 15 minutes. We were unable to survey north of Bernard Harbour to Cape Bexley due to apparent fuel shortage.

On May 1-4, 1993, we were unable to fly as overcast conditions precluded us from sighting tracks successfully.

On May 5, 1993, conditions improved in Coppermine to 600' ceiling, visibility 6 miles, and a flight was done along the mainland coast east to the mouth of Wentzel River (east Grays Bay). We returned following the northern shore of Hepburn Island, across the ice to the northern shores of the Home Islands, and towards Coppermine following the Lawford, Sir Graham Moore, and Couper Island groups. This flight resulted in observations 5-14. The flight began 14:10 hrs and terminated 17:30 hrs. Visibility and contrast conditions improved steadily in an easterly direction. Ptarmigan in flight, ground squirrels on the ground were readily visible.

On the 8th, we flew out from Coppermine, with myself and Joshua Hunter present. We began our flight at 10:00 hrs and ended it at 18:30 hrs. Weather was good, with a high scattered ceiling, and plenty of sunlight. We flew from Coppermine to Seven Mile Island, and along the north coast of the Couper

chain, then arced north to Blackberry Island. We overflew the whole island, and then continued east through the Duke of York chain. We flew into Charlie Bolt's OPC and asked concerning caribou movements. He stated that he had seen some caribou moving west on Victoria Island. We made arrangements to see him again, and flew to Ross Point for refuelling. We took 1 drum of fuel on board. A cloud front was apparent to the east, and we flew across the gulf to the midpoint of the Jameson Islands. We followed the northern coast of those islands, going east, finding no tracks. We then turned south to the Wilmot islands. We overflew these islands. The weather at this point was quite overcast. As we returned to Coppermine, we flew inland along the coast, noting caribou, as we could not make out tracks.

On the 9th, we did not fly, as I felt a trip farther east would be pointless with poor contrast conditions experienced on the 8th.

On the 10th, we moved the survey to Cambridge Bay. Weather was not very good for surveying along the coast at that time. Coppermine Weather at start of flight was scattered clouds @600', visibility excellent. We left at 15:10 hrs and arrived 19:00 hrs. While going east we passed north to the Duke of York Chain, passing over the midpoint of the Couper Chain. South of Bates Island, we intercepted Charlie Bolt as he set up for his drum haul. I gave him a set of maps, notepad and pencil to mark caribou sightings during his work. He readily accepted the work and I went on to explain the proper way to make observations. From the former fuel cache, we travelled south east to offshore of Jameson Islands.

When crossing the Gulf, clouds to the east were seen, reducing contrast on the ground and ice. We then followed the coast towards Cambridge Bay, following the shoreline of Kent Peninsula. During the weekend, we had heard reports of freezing rain conditions in the Cambridge Bay area. This was evident as we flew within 10-15 miles of Cape Alexander. The snow had a glazed appearance from the air. As we were experiencing close to whiteout conditions the closer we got to Cambridge Bay, it was decided to fly exclusively over land to improve ground reference. The survey portion of the flight was terminated at Cape Alexander, as we gained height to approach Cambridge Bay.

On the 11th, we began a flight along Kent Peninsula to Coppermine and back. Kaomayok accompanied on this flight. Weather was ceiling and visibility unlimited. We left Cambridge Bay at 12:40 hrs and flew to Cape Alexander direct at 700'. At Cape Alexander we began the survey, flying at 150' at 70-80 mph. We flew from .25 to 1 mile offshore. Contrast was quite sharp. At Patsy Klengenberg's abandoned cabins in the Wilmot Island Chain, west of Cape Flinders, we set down for refuelling. We set off again to the northern shore of the Jameson Islands, following the shoreline in the same manner as before. We continued on to Hepburn Island, and passed by the north of Port Epworth. After surveying the Port Epworth area, we climbed to 1000' ASL. This was due to a decrease in contrast, (our inability to see tracks), for fuel considerations, and

also due to the development of high winds. Head winds became quite bad west of Kuujuak River, and we were buffeted severely going into Coppermine. At Coppermine, we landed 16.50 hrs and refuelled. We were in the air at 17:35 hrs. We travelled east at 500' ASL, offshore, to avoid the worst of the winds and buffeting, until we reached Port Epworth again. On our survey east, we travelled inland to count caribou and take pellet samples. As we collected pellets, we noticed icy conditions on Kent Peninsula. The ice atop snow was thick enough to fully support a persons weight in some areas. Again, the farther east we travelled the more icy the snow became. We arrived in Cambridge Bay at 21:00 hrs.

On the 12th, we travelled due south of Cambridge Bay, on a relatively short trip. Talking with Kaomayok, I noted that there might be many caribou moving through the Melbourne Island area, along the east coast of Kent Peninsula. David also noted a lack of bulls seen in the last survey, and felt they would be farther south, and I wished to note this by flying on the east portion of Kent. I also wanted to document the snow conditions and take pellet samples in this area, as it had been bypassed in previous flights. Kaomayok and Angohaitok were along on the survey. Due to low cloud conditions south west of Cambridge Bay, we did not fly until 14:30 hrs. By the afternoon, visibility and contrast had improved as the cloud cover thinned. We flew to Cape Alexander and offshore at 150' ASL towards Trap Point. We flew on until the northern tip of the Minto Islands, and we then surveyed the islands going south onto Melbourne Island. We were unable to survey the whole island, as the pilot had trouble keeping ground reference on the low lying slopes.

We then went back through the Minto Chain, and onto the Mainland north of Labyrinth Bay. We then surveyed on shore, going north. Contrast was tested and found good, as we passed directly above the Bay Chimo-Cambridge Bay trail. We then worked our way back to Cape Alexander ashore and terminated the survey there. We then went back to Cambridge Bay, as low clouds were developing over land on Kent Peninsula, moving north.

The 13th brought the best survey run. Angohatitok and Dave Epilon were aboard for this flight. Weather was clear scattered cloud at 900', visibility excellent at takeoff. We left Cambridge Bay at 10:05 hrs. Contrast was very good, as the scattered low cloud reduced the glare on the snow. We travelled to Cape Alexander, and surveyed west offshore at 150-200' ASL at 79-80 mph. We made our way along the coast of Kent Peninsula and offshore to the Wilmot islands, we then made north to the eastern tip of the Jameson Chain. We were surveying west of the Jameson islands, when a low bank of cloud/fog obscured our way onto Hepburn Island. We then went north to obtain fuel, following the rim of the approaching cloud bank.

We took the opportunity to check in to Charlie Bolt, and landed next to the G.S.C. fuel cache in the Duke of York Chain. Luckily, Bolt was still at camp, and we put down. Charlie had not done much travelling yet, and had made few

observations. We made arrangements for him to bring his observations to the Coppermine Area Office upon his return. We the went to the Ross Point fuel cache, and took on 1-1/2 drums of fuel. As we did not use this cache again, there is now 2-1/2 drums remaining. We then proceeded back to the western tip of the Jameson Chain, and began an island survey. We then proceeded back to Cambridge Bay over land, taking pellet samples as we worked our way east. This was a very good day as we were able both to see a good many tracks, and also see many caribou actually travelling on ice. In addition, we collected a good many samples. Angohaitok and Epilon were very helpful in the collection of the samples, and also in making observations /counting.

On your advice, we did not survey during the weekend of May 15-16. I busied myself with beginning the observation entry on the computer on the 14th. With the arrival of the University of Saskatchewan Muskox calf team on Monday, I did help with some of their logistics in the Cambridge Bay office. Weather on the 17th was not conducive to flying, with only brief periods of high contrast conditions.

On the morning of the 18th, we began our last survey flight. I was the only observer on this flight, as HTA directors were unavailable. We took off from Cambridge Bay at 10:05. Weather was as follows: visibility 10 miles, 10 000' broken, 2 000' broken, winds very gusty from north east. We travelled directly towards Cape Alexander. Ice observed offshore of Kent was very glazed in appearance, and windswept clean of snow, except for narrow drifts of newer snow running north-south.

Most tracks seen on the 18th were found utilizing these narrow strips of new snow to travel on, thereby avoiding the glazed, slippery sections. It seemed very convenient that the drifts would be oriented to the caribou's natural direction of travel. We travelled over ice along the shoreline of Kent Peninsula and to the end of the Jameson Chain. We the overflew the island chain and also overland of Kent Peninsula on our way back to Cambridge Bay. On the way back we managed to obtain several more pellet samples. Towards the end of the flight, fuel considerations took over and we made straight line progress back. We landed at 2:35 P.M.

This concluded the survey, and I flew back to Coppermine the following Wednesday. During the long weekend of the 24th, I personally made a trip by snowmachine from Coppermine through Bay Chimo and onto Cambridge Bay, accompanied by George Hakungnak and Mille Angnaloak ostensibly for the Omingmak Frolics.

Enroute from Coppermine to Bay Chimo on the 21st, we did not encounter any caribou until we were 15 miles east of the mouth of Tree River. There we saw 5 young bulls on the shoreline feeding. Also, at the western tip of Hepburn Island, we saw a cow and a calf heading back to the island from the ice. The calf looked quite weak in our opinion, and the cow, which was leading, had to stop often for the calf to catch up, even at a slow walk. Off the northern shore of

Hepburn Island, there were many new tracks heading north, although we could not distinguish numbers very well; we travelled very close to the island to avoid cracks in the ice, and therefore saw very braided, wandering tracks. When we approached a crack, the tracks were seen to begin to follow them north, overlaying older tracks.

No animals were seen in the Grays Bay area until we reached a valley south of Cape Barrow used to cross into Bathurst Inlet. There, we saw 10 caribou using this natural break in the hills to make their way north.

On our way through to Bay Chimo we did not see any other caribou until 5 miles west of Bay Chimo on the ice heading north, a group of 5 caribou. Once in the bay we did note 3 caribou running through the community, and were told this often happens, and that the caribou seen around town were members of the Bathurst herd, as mentioned by Joseph Tikhak.

On the following day we travelled up through Buchan Bay, overland bypassing Cape Croker, and into Melville Sound. We continued travelling into Warrender Bay, passing overland into Elu inlet. From thence, we travelled through Itibiaryuk, and north to Cambridge Bay.

In Buchan Bay, we saw approximately 150 caribou in a loose herd travelling north along the shoreline across small points of land.

The animals tended to look quite large and dark, and I asked Hakungnak what type of caribou he thought they were. He said that he thought they were mainly Bathurst animals, although some caribou were distinctly Victoria Island in appearance. Passing by the Hurd Islands in Melville Sound, we saw scattered groups of 3-5 caribou from afar totalling 20 animals making their way north. In Warrender Bay, we saw 10 caribou travelling similarly. When we crossed north of Kuururjuak Point, we saw approximately 200 caribou in two groups heading north through small hills. Here it was difficult to say whether they were Victoria Island or not. We did see one group of 10, with only there heads showing, running by a hill. These caribou had short heads. Next, we saw another group of 20 caribou, and they were larger. The rest we saw only in the distance. Also along with the caribou, there were scattered groups of muskoxen numbering around 50.

As we made our way onto Elu Inlet, we met Ella Panegyuk's son travelling the other way. He mentioned that he had just seen a pack of 8 wolves by the trail. They quickly ran back south in amongst the islands north of Uvaajuuq Hill. He had given chase but had turned back because he was scared of the thin ice found among these islands.

In Elu Inlet, we saw approximately 30 caribou in small groups heading north. We saw all of them reaching the southern shore of Kent Peninsula, and none out in the inlet to our right, and it seemed to me that the crossing of the inlet must be made in small spurts, and not gradually by individual groups of caribou crossing the channel as they came to it.

As we crossed Itibiaryuk, we saw 5 caribou travelling in the hills by the

trail. There were many tracks crossing the trail, all would be considered new. Another 2 caribou were seen by a small cabin, and George and I decided to hunt them. As we stalked them, we soon saw that they were older "mainland" type bulls. We did not shoot at them.

As soon as we got the ice of Queen Maud Gulf, we did not see any caribou for the rest of the trip.

The trip back to Coppermine began late May 27. During this trip, we travelled quite fast, making Bay Chimo in 6.5 hours and Coppermine in 14. Because we were travelling so fast, and also due to high winds near Tree River, we did not note any caribou movements.

My overall impressions of the caribou crossing are as follows. Caribou seemed to move off the mainland west of Bathurst Inlet sooner than on Kent Peninsula. Also, caribou noted west of Bathurst Inlet are more certainly Victoria Island in appearance than those on Kent Peninsula. I also note that caribou seen in the western portion of the Gulf appeared calmer when faced with our helicopter flights. The southern shoreline and adjacent islands seemed to be used as staging areas for the crossing, with caribou foraging extensively before the trip over ice. Also, there are some observations I made that would suggest that calves have difficulty in crossing.

Survey flights were conducted during the day, and I suspect most of the caribou movements occurred during the night. The snowmobile trip I took was during the night, and I did not see any caribou resting. Towards the end of the survey, caribou tracks were seen concentrated on sides of cracks coming off at right angles to the shoreline. The main movement of caribou off of Kent Peninsula seemed to occur during the last flights of the survey, although caribou in large numbers were still seen travelling north after the survey.

OBSERVATIONS

30/04/93

1. 13 old caribou tracks heading west-trudging onto shore at 3 miles north of Locker Point (68.18.28-113.39.45).

2. 1 old track heading west-trudging onto shore 5 miles north of Locker Point (68.21.80-113.55.69).

3. 4 Victoria Island caribou (2 yearlings/2 Cows), foraging ½ mile east of the un-manned radar site at Bernard Harbour (68.45.37-114.56.34). Incidental to this was sighting more than 20 Arctic Hares in a "herd", adjacent to the older, previously manned site.

4. 10 muskoxen, encircled, sighted 10 miles south of Bernard Harbour at (68.33.72-114.59.19).

TOTAL FLYING TIME-2.3 HOURS

03/05/93

5. 4 caribou tracks heading west across the mouth of Asiak River on eastward facing cliffs on ice (67.45.62-114.19.73). Tracks new and fairly distinct despite overcast conditions. 2 miles east at (67.45.90-114.16.65), kill site found, numerous ravens.

6. Initially 15 caribou sighted, and on circling, more than 100 in scattered groups walking along the shoreline heading west, 7 miles east of Asiak River (67.44.03-114.02.40). Caribou initially difficult to see due to them walking through rocky islands. Good look at B.G. caribou for differentiating later.

7. 4 caribou sighted resting on land at (67.43.60-113.58.26).

8. Scattered groups of caribou (Peary+?) sighted overland as crossing to shoreline east of Port Epworth (67.44.36-111.47.04). Area consisted of rocky plateau. Sighted browsing, disturbed by helicopter. 4 groups of 22,27,3,3, caribou respectively. Group of 3 sighted very dark and large in comparison. One Victoria Island caribou sighted with red marks on posterior.

9. 5 caribou sighted running along bare rock on island 1-2 miles east of Port Epworth. Animals readily ran from helicopter, as they could be seen from a distance away trying to evade us. Position, (67.45.78-111.43.88).

10. 23 caribou sighted milling on corner of island 7 miles north east of Port Epworth (67.45.23-111.35.41), adjacent to a cross-like cairn. Opportunity taken to set down and photograph animals. On ground 10-15 minutes allowing for refuelling. Photos taken also of feeding craters. Snow very wet next to ground. No recent pellets found in vicinity. Urine spots found-pinkish in colour.

11. 35 caribou sighted crossing from mainland onto 50-100 hectare island-bare rock at (67.45.84-111.26.46). Circled for count, set down on seaward portion of island-photos taken. Animals easily spooked into travelling back onto mainland. Incidental to this, across bay from sighting, Raptor seen flying along cliff face. Observation made 5 miles west of Grays Bay.

12. 3 caribou sighted on top of plateau, adjacent to east facing cliff facing Grays

Bay at (67.49.34-111.07.85). 1 cow/calf pair evident. Caribou resting/feeding.

13. 100+ caribou sighted on north shore of Hepburn Island. No tracks sighted onto Hepburn island from Grays Bay side-Caribou must have been on island during the weekend's snowstorm. First sighted 500' inshore. Noted location of resting cow/calf. Landed, Pellet samples #1-2 taken. Photos taken of whole group and pellet sites, including crater sites. One site shows extensive feeding on willows. One "mainland" caribou sighted and photographed. Caribou seen walking onto ice, flew over/photos taken of caribou leaving island going north. Location (67.56.72- 110.53.32). Urine stains pinkish in colour.

14. 30 caribou sighted on ice heading north in line at (67.56.35-110.58.10), 2 miles off Hepburn Island. Separate group of 15 caribou following closer to shore.

TOTAL FLYING TIME-3.5 HOURS

08/05/93

15. Group of 11 and 20 caribou feeding in the middle of BlackBerry Island, at (68.11.00-113.17.76). Fairly calm at pass over. Pictures taken.

16. 8 definitely Victoria Island caribou found feeding in middle of Nanukton Island (68.08.96-112.50.57). Landed beside animals and stalked within 70'. Breakdown of herd as follows: 3 Cow/Calves, 2 young bulls. Pellet samples #3-6 taken, all definitely from either cow or calf. Photos taken of both caribou and craters. Urine spots seen as yellow.

17. Groups of 18,4, and 3 (2 Cows/1 calf) seen on Takhoalok Island (68.10.49-112.07.80). Animals feeding calmly, even after 2 passes for pictures.

18. 9 Victoria Island seen feeding on Murray Island (68.26.34-111.04.35). Only 1 calf seen. Animals feeding on open ridge, adjacent to herd, a group of 10 muskoxen seen.

19. Groups of 24 and 4 muskoxen seen feeding on Edinburgh Island (68.30.82-110.59.07).

20. Groups of 30,1, and 4 Victoria Island caribou seen on Wilmot Islands (68.11.91-109.04.20). Animals mainly feeding on higher ridges in centre of island. Pictures taken.

21. 20 caribou seen resting/lying down on Jameson Islands (68.11.21-

109.41.55).

22. Groups of 103, 115, 8, 2, and 18 seen on Jameson Islands in vicinity of (68.07.66-109.51.78). Seen running through rocky, upland portion of island, difficult to see until disturbed.

23. Groups of 120,17,15,25,15,3,8,23 seen on Jameson Islands in vicinity of (68.05.62-110.01.42). The group of 23 seen in-between islands headed north from mainland. Pictures taken with islands in background, caribou moving in middle.

24. 22 caribou seen disturbed in Jameson Islands at (68.02.38-110.18.59). Picture taken.

25. 25 caribou seen disturbed in Jameson Islands at (68.01.68-110.19.30).

26. Groups of 9, 20 and 51 seen on western tip of Jameson Chain in vicinity of (68.01.42-110.23.29).

27. 3 caribou seen feeding on Hepburn Island at (68.02.22-110.37.10).

28. 5 caribou seen feeding on mainland at (67.51.73-110.40.56). Animals on low, vegetated northern part of island.

29. 3 new caribou tracks seen along shoreline headed west in Grays Bay at (67.46.92-111.04.52).

30. 11 caribou seen inland in valley, headed east towards Grays Bay at (67.45.61-111.12.33).

31. 13 caribou seen inland in valley disturbed and heading south at (67.44.68-111.16.74).

32. 3 caribou coming onto ice heading north east at (67.44.52-111.21.94).

33. 6 caribou inland feeding at (67.43.63-111.26.83) east of Port Epworth.

34. 4 caribou following 3 new tracks onto ice heading north at (67.43.82-111.40.33), east of Port Epworth.

35. 8 caribou walking north on plateau north of Port Epworth, following braided new tracks at (67.43.83-111.48.36). In previous flights, many caribou seen this location, only 8 seen now.

36. 12 caribou seen on west side of Port Epworth, heading north along shoreline at (67.42.21-111.57.58).

37. 3 new caribou tracks seen heading north, west side of Port Epworth along lake at (67.40.87-112.07.99).

38. 3 caribou seen that made tracks in #38. Went around bluff, heading north on river bed towards gulf at (67.40.92-112.13.79).

39. Groups of 5, 15, and 27 caribou seen in vicinity of (67.41.74-112.23.16). All along shoreline. The group of 27 head were seen to go onto the ice and start heading north in line. In addition wolf tracks, then a grey wolf was seen patrolling the shoreline 1 mile farther west of caribou, heading west. Pictures taken, 1 fast pass.

40. 4 caribou seen resting on shoreline at (67.40.27-112.44.67).

TOTAL FLYING TIME-5.5 HOURS

10/05/93

41. 7 caribou seen in line galloping off the northern shore of the Couper Island chain heading northwest at (67.59.87-113.58.56).

42. 12 caribou seen on ice heading east at south side of the eastern tip of the Jameson Island chain at (68.17.40-109.17.47).

43. 7 caribou seen 1/4 mile inland on Kent Peninsula north of Walker Bay, walking north until disturbed at (68.20.81-108.42.13).

44. Groups of 3 and 5 caribou each found resting in the vicinity of (68.22.94-108.31.64) on Kent Peninsula south of Turnagain Point.

45. Groups of 5,8,7, and 10 caribou seen in vicinity of (68.24.68-108.31.05), south of Turnagain Point.

46. Groups of 5,4, and 16 caribou seen in the vicinity of (68.26.19-108.31.75), south of Turnagain Point.

47. 10 caribou seen at (68.27.19-108.28.28), lying down, Kent Peninsula.

48. 5 caribou seen lying down on ridge, adjacent to Cape Franklin at (68.27.06-

108.25.23).

49. Groups of 3,5,and 14 seen feeding along a open ridge near (68.29.27-108.24.37), Cape Franklin.

50. 11 caribou seen resting along ridge at (86.30.96-108.20.79) adjacent to Turnagain Point.

51. Groups of 13 and 4 seen both resting and feeding by Turnagain Point (68.32.35-108.24.09).

52. Groups of caribou scattered closely together numbering 36,16,14,2,17,7,15, 11, and 3 respectively feeding and resting along ridges and patches of open ground, making them difficult to count/see at (68.35.12-108.16.97).

53. Groups of 13 and 15 caribou seen feeding and resting at (68.36.23-108.14.39), Kent Peninsula.

54. Groups of 20,14,17,4,10 and 7 caribou seen along a ridge at (68.37.61-108.13.11), on Kent Peninsula.

55. Groups of 38,31,3 and 51 caribou seen atop a hill at (68.37.67-108.09.42), Kent Peninsula.

56. Groups of 25 and 2 caribou seen resting along a ridge at (68.37.80-108.02.77).

57. 103 caribou seen, scattered in pairs, in vicinity of (68.37.44-108.00.87), Kent Peninsula.

58. Groups of 62 and 3 caribou seen near (68.37.10-107.57.20).

59. Groups of 2, 3, 65, and 35 caribou seen on north side of hill, along with herd of 20 muskox, in vicinity of (68.37.09-107.48.62).

60. Groups of 4,2,2,11, and 6 caribou seen scattered in vicinity of (68.38.18-107.42.56). 2 animals seen in these groups that were dark and large- mainland caribou.

61. Groups of 15,3 and 17 caribou seen, all resting along patches of open ground near (68.38.24-107.27.80), on Kent Peninsula.

62. Groups of 16 and 2 caribou seen feeding near (68.41.61-107.17.37), on

Kent Peninsula.

63. Groups of 8,3,23,1,3 and 3, caribou seen mainly resting on open ground in vicinity of (68.43.59-107.07.66), Kent Peninsula. One animal seen amongst these groups that was especially dark and large-mainland caribou.

64. Groups of 12,5,5 20, and 11 caribou seen 1 mile inshore as shoreline became indistinct, we flew farther inland than anticipated. Caribou located in vicinity of (68.45.36-107.00.53).

65. Widely scattered herds of caribou seen, as shoreline became indistinct. Seen in groups of 5,25,15,9,2,17,2,3, and 2 caribou in general vicinity of (68.45.40-106.57.42). Animals seen mainly disturbed as we were flying low to the ground during this section.

66. Widely scattered herds of caribou seen, in groups of 20,21,18,54,2,2 and 3 animals each. Seen both resting and feeding in general vicinity of (68.48.44-106.33.78).

67. Groups of 91, 13 and 2 caribou seen, widely scattered over north facing hill side, mainly feeding in small open areas of ground, in vicinity of (68.51.45-106.25.86).

68. Scattered groups of 42, 100 and 9 caribou seen in vicinity of (68.53.90-106.15.52), near Cape Alexander.

69. Groups of 19 and 10 caribou seen on top of hill, and on shore line respectively at Cape Alexander at (68.55.32-106.12.07).

TOTAL FLYING TIME-3.3 HOURS

11/05/93

70. Groups of 35 and 5 caribou seen angling onto ice from shoreline by spit of land at (68.55.28-106.13.72), Kent Peninsula.

71. 3 caribou on ice heading north, 1 resting 2 walking at (68.52.76-106.36.17).

72. 2 caribou feeding along shoreline of Kent Peninsula at (68.44.48-107.08.72). Winds fairly high this location, some ground drift seen.

73. 73 caribou heading north in line onto ice on shoreline at (68.37.80-

108.06.22).

74. 10 caribou on north facing slope by shoreline, feeding at (68.38.27-108.11.88).

75. 1 new trail seen (Possibly 4 animals) heading north off the Jameson Islands at (68.12.87-109.43.35).

76. 1 caribou walking north east through channel in-between Jameson Islands at (68.10.06-109.51.85), tracks of animal easily distinguished.

77. 2 tracks and 1 trail, both old, seen meandering north west off the western tip of Jameson Islands on ice, at (68.02.15-110.25.79).

78. Groups of 40 and 4 caribou walking NNW on ice off Hepburn Island at (67.57.24-110.49.72). Contrast conditions deteriorating rapidly, could not see tracks.

79. Groups of 10 and 3 caribou milling on lake west of Tree River at (67.40.10-112.09.83).

80. 14 caribou seen resting on east side of lake mentioned in 81., at (67.40.79-111.57.56).

81. 5 caribou heading north west on shoreline onto ice at (67.45.85-111.21.81).

82. Groups of 16,4,23, and 8 caribou seen inland on Jameson Island. Pellet samples 7-11 taken at (67.47.84-111.17.27).

83. Groups of 5, and 3 caribou seen running atop plateau on within Hepburn Island chain at (67.52.78-110.58.00).

84. 9 caribou seen running on hill, Jameson Island Chain, (67.55.25-110.51.38).

85. Scattered herd of 110 caribou seen in Jameson Island Chain at (68.02.03-110.18.62). Landed, pellet samples 7-13 taken, including pictures of craters. This herd less spooked than others.

86. 30 caribou seen resting/feeding atop plateau on Jameson Island Chain at (68.04.46-110.07.44). Animals calm.

87. 26 caribou seen on ice heading through gap in Jameson Island Chain at (68.03.79-110.06.52). Herd in line heading north west. Landed. Pellet samples

14-20 taken. Pictures taken of animals with islands in background.

88. Groups of 10 and 8 caribou seen feeding in close proximity at (68.04.68-110.03.79), in Jameson Island Chain.

89. 16 caribou seen leaving the shoreline of Jameson Islands onto ice, heading NNW, at (68.06.13-110.00.98). Incidental to this, saw white-fronted geese on shoreline.

90. 29 caribou seen spooked and running hard in island in Jameson Chain at (68.06.39-109.55.65).

91. 30 caribou seen running on island in Jameson Chain at (68.07.35-109.52.32).

92. Group of 19 caribou on shoreline, including 1 lone caribou on ice nearby, resting and calm at (68.08.80-109.50.55).

93. Groups of 10,2,8, and 14 caribou seen at Cape Flinders, Kent Peninsula, at (68.27.97-108.26.67). Overcast conditions, blue sky to east.

94. Scattered groups totalling 110 caribou seen on Kent Peninsula near Cape Flinders at (68.33.69-108.20.65). Animals fairly calm, running short distance when A/C landed. Pellet sample #21 collected. Pictures taken of craters.

95. 27 caribou seen resting on higher raised beaches at (68.34.87-108.18.56).

96. 30 caribou seen feeding/resting at (68.36.52-108.17.14), Kent Peninsula. Landed, pellet sample #22 taken. Picture taken of site. Snow has very thick icy crust due to recent freezing rain in area. Very noticeable, ice will bear persons weight.

97. 40 caribou seen on raised beach on edge of plateau, resting at (68.37.30-108.09.12), Kent Peninsula.

98. Groups of 14 and 4 caribou seen at (68.37.92-108.04.93). Pilot raises fuel concerns, decided to bee line to Cambridge Bay along coast. Increase air speed to 120 knots/hour.

99. Widely scattered groups totalling 191 caribou seen feeding along shoreline of Kent Peninsula in general area of (68.37.79-107.55.17).

100. 9 caribou seen first feeding, then moving out of path of A/C in lethargic

manner at (68.38.00-107.47.47). Pilot switched to G.P.S. to get direct course to Cambridge Bay from present location (Hargrave river?).

101. Widely scattered groups of caribou numbering 4,3,6,2,1,2, an 4 in general location of (68.45.86-106.55.08).

102. 12 caribou seen intensively feeding at (68.48.23-106.43.50). caribou paid no notice of A/C flying directly overhead.

103. Scattered groups numbering 44,2,7 and 19 seen intensively feeding at (68.51.80-106.24.24).

TOTAL FLYING TIME-7.5 HOURS

12/05/93

104. Groups of 6 and 3 (no bulls) caribou feeding on shore at Trap Point, (68.54.46-105.53.79).

105. 4 old tracks headed west onto Nunaritgak Island at Trap Point, (68.53.12-106.46.70).

106. Groups of 9 and 8 (no bulls) caribou headed north along the shore of Kent Peninsula at (68.47.50-105.32.72).

107. 8 caribou (no bulls) seen feeding at (68.44.62-105.26.51).

108. Groups of 2 and 8 caribou seen (no bulls) on shore of Minto Islands at (68.35.26,105.18.52). Incidental to this, 2 muskox were seen adjacent to the caribou.

109. Groups of 8 and 12 caribou (no bulls), seen on Minto Islands at (68.33.21-105.08.32).

110. Groups of 11 and 12 caribou (2 young bulls) seen feeding on Melbourne Island, mainly along small raised beaches. Caribou having great difficulty walking due to iced snow conditions. Landed. Ice atop snow 1-1/4" thick on drifts, and covering windblown open ground. Pictures taken of cratering/pellets. Pellet samples #23-24 taken.

111. 11 caribou seen heading south, 1 mile south on Melbourne Island at (68.34.01-104.57.30). Caribou seen from far-icy conditions would have made

approach by A/C hazardous to animals. 6 muskoxen seen nearby.

112. 22 caribou seen along rise near middle of Melbourne Island at (68.34.95-104.51.28). Did not approach closely, although 1 animal seen to fall down as the herd moved off away from A/C.

113. 29 caribou seen feeding/resting in one spot along rim of raised beach, Melbourne Island, (68.34.37-104.45.91). Appeared calm. Approached caribou, noticed from air 1 red fox begin to chase caribou. Came close to 1 animal, which ran away. The fox then ran away. heading south. Landed below herd. Pictures taken of cratering/pellets. Pellet samples #24-27 collected. Ice on raised beach 1/4" thick, crusty, and easily broken through.

114. Groups of 20,11 and 5 caribou seen (1 adult bull amongst group of 5) at (68.33.66-105.26.12).

115. 5 young bull caribou, and ½ mile distant a cow/calf, seen near (68.40.94-105.36.31). All feeding.

116. Groups of 6 and 4 caribou (1 young bull included), seen on mainland 2 miles inland along an esker at (68.42.84-105.37.95).

117. Scattered groups of caribou numbering 14,5,2,9, and 11 on hillside above shoreline heading generally north/feeding on Kent Peninsula at (68.46.36-105.33.12).

118. Scattered groups of caribou numbering 39,10,9,3 and 2 in vicinity of (69.49.48-105.42.23). Landed. Pellet Samples #28-29 collected at top of hill. 2 Pictures taken. Ice 3/4" thick over snow.

119. Groups of 18 (1 Bull), 5, and 2 caribou seen inland, behind bluff from Trap Point, in vicinity of (68.52.03-105.47.05). Landed. Pellet sample #30 taken. Pictures taken. Ice 3/4" thick over snow.

120. Groups of 19 and 6(1 young bull) caribou seen atop plateau near (68.51.89-105.53.09). 2 muskox with calf seen close by.

121. 7 caribou seen aside river at (68.52.65-105.57.87).

122. 23 caribou seen in valley inland from Cape Alexander at (68.53.84-106.05.28). Pellet sample #31 collected, pictures taken of site. Ice ½" thick.

TOTAL FLYING TIME-2.7 HOURS

13/05/93

123. 2 new trails (est 20 caribou) and 3 tracks seen on ice off Cape Alexander heading north at (68.56.39-106.05.54).

124. 5 young bulls together, and a mixed cow/calf group of 13 caribou seen in single file walking north on ice 1/4 mile offshore of Kent Peninsula at (68.56.92-106.10.92).

125. 1 very new trail (5-6 caribou including 1 calf), and 2 single tracks seen heading north west, south of Norburg Island at ((68.56.39-106.19.24). Animals selecting new snow drifts with less ice to walk on.

126. 4 new tracks consisting of 2 cow/calf groups, walking spaced out over rough ice, heading north, east of Hargrave River at (68.46.40-107.04.27).

127. 4 unidentified caribou following 2 old parallel trails (estimated 10 tracks total), heading north, west of Hargrave River at (68.39.04-107.59.98).

128. 9 new individual tracks seen spaced out over rough ice, heading north, west of Hargrave River at (68.38.80-108.08.51).

129. 6 new individual tracks seen heading north west on ice, at (68.38.81-108.09.33).

130. Braided trail consisting of mainly cow calf groups numbering approx. 18 individual tracks seen heading north on ice at (68.38.16-108.16.37).

131. 1 new track of calf/yearling heading south onto Kent Peninsula at (68.35.26-108.25.11).

132. Braided old trail of 3-4 animals seen heading north west 15 miles east of Cape Flinders at (68.32.46-108.28.43).

133. 6 caribou (no bulls) seen 1-1/2 mile offshore heading north, 10 mile east of Cape Flinders, at (68.27.96-108.33.78).

134. 2 new trails (approximately 20 animals total) heading north off the east tip of the Jameson Island Chain at (68.17.81-109.26.52).

135. 1 new braided trail consisting of 10 tracks, and 2 new lone tracks heading north, on ice, 2 miles from eastern tip, at (68.16.35-109.31.63).

136. 6 new braided tracks heading north off shore of Jameson Islands at (68.13.75-109.41.11).

137. 4 unidentified caribou walking back onto shore, heading south east at (68.11.40-109.48.95).

138. 6 new major trails connecting offshore as caribou follow side of ice track heading north, and 6 caribou following trail seen at same time at (68.10.43-109.51.90).

139. 6 new tracks seen braiding together heading north off shore of Jameson Islands at (68.06.91-110.03.83).

140. 3 new tracks on ice heading north at (68.05.87-110.10.46).

141. 5 caribou seen heading north 5 miles offshore of western tip of Jameson Islands, 1-1/2 miles west of small islands at (68.08.18-110.21.84).

142. 6 old tracks heading north east along north shore of Bates Island at (68.22.61-111.28.19).

143. Braided new tracks headed north numbering 30 converging from the gulf onto small island due south of unmanned D.E.W. site on Edinburgh Island at (68.21.53-110.54.54).

144. 24 caribou resting on ice 15 miles from shore in mid gulf at (68.03.45-110.59.30).

145. Groups of 8, 9 and 11 caribou running atop hill on Hepburn Island in vicinity of (67.52.32-111.01.12).

146. Groups of 12, 2, and 4 caribou running on Hepburn Island in vicinity of (67.54.51-110.52.53).

147. 40 caribou in loose group resting on hillside, Hepburn Island at (67.57.21-110.48.34).

148. 9 caribou heading north along side of ice crack in-between Hepburn Island and Jameson Chain at (68.01.57-110.38.54).

149. 8 caribou resting on island at (68.02.52-110.36.12).

150. 8 caribou seen heading north on ice offshore of western tip of Jameson

Islands at (68.01.96-110.26.59).

151. Groups of 13 and 7 caribou seen feeding on Jameson Islands at (68.01.62-110.24.34).

152. 6 caribou feeding on lower slope of Jameson Islands at (68.01.52-110.22.50).

153. Groups of 3, and 4 caribou seen resting on Jameson Islands at (68.02.62-110.18.70).

154. Scattered groups of caribou seen feeding on raised beaches numbering 7,2,47,8,4 and 3 respectively in general area of (68.03.76.110.09.77).

155. 57 caribou seen in loose group feeding on Jameson Islands at (68.05.91-109.58.92).

156. Scattered groups of caribou seen numbering 3(bulls), 9, 16, 15, and 7 respectively feeding and resting in general area of (68.08.40-109.51.34).

157. 1 lone caribou and group of 5 nearby seen feeding on island at (68.14.56-109.33.05).

158. 5 caribou seen running on Jameson Islands at (68.15.97-109.28.05).

159. 8 caribou seen feeding on raised beach at Cape Flinders at (68.15.93-108.46.85).

160. 17 caribou seen on shoreline, resting, 5 miles east of Cape Flinders at (68.20.15-108.39.16).

161. Groups of 9 and 5 caribou seen adjacent to each other at (68.24.61-108.31.30), Kent Peninsula.

162. Groups of caribou seen in close proximity, numbering 8, 10 and 4, 10 miles east of Cape Flinders. Landed beside herd. Took Pellet sample #32. Pictures of cratering and animals taken. Ice 1" thick over snow, but not very slippery-small bumps seen on surface (hale?). Location (68.26.49-108.27.32).

163. 17 caribou seen on shoreline feeding, Kent Peninsula, at (68.29.82-108.26.26).

164. Scattered groups of caribou seen feeding, numbered 11,4,7 and 5 animals

respectively in vicinity of (68.31.40-108.23.79).

165. Scattered groups of caribou in vicinity of (68.33.77-108.22.49). Group of 22 caribou seen heading onto ice going north. Groups of 32,41 and 6 seen feeding on shore, slowly walking north. Landed adjacent of herd of 41 animals. Took Pellet Samples #33-34. Photos taken of caribou and craters. Ice found to be ½" thick on side of craters. Surface bubbled.

166. Widely scattered groups of caribou seen numbering 15,20,25,17,70,27 and 7 in general vicinity of (68.35.98-108.20.34), Kent Peninsula. Many animals seen resting on open ground/raised beaches, and feeding adjacent to these areas. Animals difficult to see resting on ground, and seen only when disturbed.

167. Scattered groups of caribou seen in general area of (68.36.64-108.14.37), numbering 9,2,7,3, and 7 animals respectively.

168. 2 groups of caribou seen adjacent to each other numbering 33 and 6 caribou each, at (68.37.68-108.06.02), Kent Peninsula.

169. Scattered group of 68 caribou seen at (68.37.18-108.02.53), feeding and slowly moving north. Landed. Pellet Samples #35-36 taken. Pictures taken of craters and caribou. Ice measured 1/4" thick and bubbly.

170. Scattered groups of caribou numbering 6, 20, 5, and 18 animals seen feeding down slope of a group of 20+ muskoxen seen same location previous flight, at (68.37.31-107.58.63).

171. 14 caribou seen resting, Kent Peninsula (no bulls) at (68.38.85-107.43.49).

172. 5 caribou seen feeding across a small stream from a group of 4 muskoxen at (68.39.19-107.38.97).

173. Groups of 22, 15 and 1 caribou seen resting at (68.39.52-107.28.94).

174. Widely scattered groups of caribou seen feeding along open ground in general vicinity of (68.40.00-107.24.14), numbering 3, 35, 8, 4, 42, 25, 7, 8 and 9 each.

175. 3 groups of 5 caribou each seen resting in general vicinity of (68.41.97-107.11.16).

176. 7 caribou seen resting at (68.44.05-107.06.72).

177. 17 caribou seen feeding along ridge at (68.45.41-107.00.00).

178. Scattered groups of caribou seen feeding down slope of 41 muskoxen (3 calves), numbering 5, 9, 5, 4, and 3 animals respectively at (68.46.21-106.54.43).

179. Scattered groups of caribou seen feeding adjacent to 10 muskox, numbering 10, 21,4 and 10 animals each at (68.48.77-106.41.29). From this point, the survey was conducted in straight line to Cambridge Bay, due to fuel considerations.

180. Widely scattered groups of caribou feeding on western approaches to Cape Alexander, numbering 32, 9, 7, 2, 7, 10, 7, 22, 45, 10 and 41 animals respectively, in vicinity of (68.51.78-106.26.76). Much open ground evident.

181. Groups of caribou numbering 15, 71 and 5 intensively feeding on eastern slopes of Cape Alexander, adjacent to a group of 7 muskoxen (no calves), at (68.55.26-106.10.45).

TOTAL FLYING TIME-6.5 HOURS

18/05/93

182. 1 new trail and 7 new tracks seen headed north from Cape Alexander at (68.56.67-106.10.60).

183. 1 new trail and 13 individual tracks seen headed north from Cape Alexander at (68.56.79-106.11.99).

184. 1 new trail and 15 individual tracks also seen headed north west of Cape Alexander t (68.56.31-106.13.48).

185. 3 old tracks headed north, and 4 new tracks headed west at same location (68.54.96-106.18.78).

186. 14 new tracks headed north onto small low island off mainland by (68.53.85-106.24.04).

187. 21 new tracks headed north east, and same location, 4 new tracks headed west (same as 185?), at (68.53.34-106.26.49).

188. 12 new tracks headed east on ice at (68.52.55-106.30.46).

189. 14 new tracks headed north on ice at (68.52.06-106.32.97).

190. 26 old tracks headed north, drifted in places, going onto island at (68.51.71-106.35.44).

191. 3 new tracks headed east on ice by islands, parallel to shore, crossing 2 old tracks heading north at (68.51.56-106.36.40).

192. 1 old track headed north on ice by (68.50.49-106.40.02).

193. 1 new trail, no braiding, headed north at (68.49.19-106.49.11).

194. 2 old trails, and 1 old track besides, headed north at (68.39.17-107.52.07).

195. 1 new trail and 1 lone track headed north at (68.38.77-108.02.32).

196. 1 old major trail, very braided, at least 5 hoof prints across, drifted in headed north at (68.38.81-108.05.03).

197. 1 old trail headed east crossed by new trail (11 caribou) headed north at (68.38.52-108.11.33).

198. 3 separate new trails, included with 4 discernable new tracks, all headed north at (68.38.30-108.12.86).

199. 24 medium aged tracks headed north braided together at (68.38.35-108.13.61).

200. 4 medium aged major trails included with 9 medium aged discernable tracks all heading north at (68.38.24-108.16.30).

201. 3 new trails, all animals walked in line, heading north at (68.37.44-108.18.59).

202. 1 new trail heading north east at (68.36.62-108.21.60).

203. 4 caribou seen heading north on ice at (68.31.63-108.28.91).

204. 6 old tracks headed north at (68.30.35-108.30.45).

205. 3 new tracks headed north at (68.28.44-108.32.24).

206. 1 new trail, all walked in line, headed north at (68.27.13-108.33.81).

207. 10 new tracks headed north at (68.25.38-108.35.01).

208. 2 new trails, headed north at (68.23.05-108.40.32).

209. 2 new trails, all walked in straight line, at (68.22.05-108.42.54).

210. 4 new trails, and, 4 individual tracks headed north at (68.20.66-108.44.09).

211. 2 old, drifted in trails headed north at (68.18.37-108.47.04).

212. 18 old tracks and 3 new following them north west off Cape Flinders onto ice at (68.16.96-109.49.00).

213. 7 caribou seen headed north off of island onto ice at (68.15.48-109.07.56).

214. 3 new trails seen headed north off of eastern tip of Jameson Islands at (68.17.81-109.26.52).

215. 14 interwoven new trails coming off of Jameson Islands headed north in vicinity of (68.16.35-109.31.63). A/C flying too close to islands, picking up trails of caribou movements along shoreline, moved back out from shoreline at 1/4 mile.

216. 13 new tracks seen headed north at (68.15.48-109.34.74).

217. 2 new trails headed north on ice at (68.14.53-109.38.21).

218. 5 new trails (estimated 20 tracks), headed north from Jameson Islands at (68.13.09-109.40.95).

219. 1 new trail, following 1 old track headed north at (68.12.79-109.44.37).

220. 7 new braided trails (estimated 35 tracks), headed north at (68.11.02-109.50.42).

221. 6 new trails (estimated 30 tracks), headed north at (68.09.92-109.53.44).

222. 2 new tracks following 3 old tracks headed north at (68.08.49-109.56.69).

223. 1 new trail following 1 old trail headed north at (68.06.87-110.02.60).

224. 6 new tracks headed north at (68.05.61-110.08.91).

225. 15 old trails, drifted in, interwoven (estimated 40 tracks), headed north at (68.05.06-110.10.66).

226. 5 old trails, drifted in, interwoven (estimated 15 tracks), headed north at (68.04.13-110.13.55).

227. 34 old tracks seen in-between island headed north at (68.03.42-110.18.09).

228. 20 old tracks headed north at (68.03.23-110.19.38).

229. 1 cow/calf group seen on island, cow had red discolouration on rump, at (68.02.93-110.15.64).

230. 1 young bull, 8 cow/calf groups and 10 unidentified caribou (total 27) seen on island feeding at (68.03.05-110.10.46).

231. 2 cow/calf groups alone, and herd of 54 caribou (total 58), seen feeding on Jameson Island at (68.04.00-110.05.00).

232. 1 young bull, including 3 cows seen feeding on Jameson Islands at (68.06.23-109.53.84). Survey straight line to Turnagain Point.

233. 5 bulls and 1 cow/calf group seen on land feeding at (68.07.54-109.50.37).

234. 4 young bulls and 6 cow/calf groups, and 2 cows (total 18), seen together at (68.10.50-109.42.34).

235. Groups of 21 and 4 caribou seen feeding at (68.13.20-109.36.28).

236. 7 cows together feeding seen on Jameson Island at (68.14.65-109.32.00).

237. 6 unidentified caribou seen feeding at (68.15.24-109.29.29).

238. 2 caribou, definitely mainland, adjacent to 1 cow/calf group at (68.29.74-108.21.83).

239. Groups of 1, 4, and 13 caribou seen inland on Kent Peninsula at (68.33.95-108.00.07).

240. Groups of 8, 15, and 12 caribou see feeding on hillside below group of 20 muskoxen, all seen in vicinity of (68.35.82-107.50.00).

241. Scattered groups of 89 caribou total feeding on north slope of Kent Peninsula adjacent to group of 4 muskoxen (same place), at (68.38.21-107.38.68).

242. Many scattered caribou totalling 100+ caribou feeding along coastline at (68.41.61-107.19.27).

243. Wolf kill site, tracks evident, 5 ravens present, caribou carcass drifted in, estimated kill date Friday or later. Did not land, fuel quite low. Location (68.41.61-107.19.27).

244. 23 caribou in loose group, feeding at (68.43.81-107.09.40).

245. Many scattered groups of caribou, most of ground cratered. Groups numbered 20, 50, 7, 12, 8, 2, and 15, in vicinity of (68.45.44-107.00.00).

246. Many scattered groups of caribou, most of ground cratered in this area. Groups numbering 6, 5, 9, 30, 27, 4, 6, 48, 8, 10, 3, 8, 5, 61, 9, 3, 24, 12, 13, 4, 5, 7, 2, and 2. Located in general area of (68.46.58-106.54.51). Caribou moving off to north and onto ice as disturbed.

247. 5 muskoxen sighted again, same location.

TOTAL FLYING TIME-4.1 HOURS

SURVEY TOTAL-35.4 HOURS

APPENDIX C. Observations of muskoxen on and off transect during an aerial survey of Melbourne Island, Northwest Territories, 11 March 1994.

Transect Number Transect	Transect Area (km^2)	Left Observer	Right Observer	Total On	Off
1	22.0	0	0	0	9
2	26.0	0	7	7	5
3	30.5	0	0	0	0
4	34.0	0	0	0	0
5	31.0	0	0	0	68
6	25.5	7	8	15	0
7	16.0	0	0	0	12
	185.0	7	15	22	94

APPENDIX D. Caribou observed on transect during an aerial survey of Melbourne Island, Northwest Territories, 11 March 1994.

Transect Number	Transect Area (km^2)	Left[1] Observer	Right[1] Observer	Total On
1	22.0	22	3	25
2	26.0	20	35	55
3	30.5	29	59	88
4	34.0	32	52	84
5	31.0	22	17	39
6	25.5	3	28	31
7	16.0	10	12	22
	185.0	138	206	344

[1] Paired t-test performed (both normality and equal variance test passed); $t_{(2)}$=-1.45, d.f.=6, P=0.20

Power of performed test with α set at 0.05: 0.14

APPENDIX E. Weather and technical details of Melbourne Island survey.

GENERAL INFORMATION:
DATE: 11 March 1994
LOCATION: Melbourne Island
SPECIES: Muskoxen and Caribou
SURVEY TYPE: Systematic Strip Transect
AIRPLANE: Helio-Courier
ALTITUDE: 200 m
AIR SPEED: 160 kmph
STRIP WIDTH: 1000 m / side

CREW:
- Pilot: Perry Linton
- Navigator: George Angohiatok
- Left Observer: Luke Coady
- Right Observer: John Nishi

LOGISTICS:
- Take-off time: 1305 h
- Landing Time: 1609 h
- Total Flying Time: 3 hours, 4 minutes
- Ferry Time:

- Time on Transect: 39 minutes (transects 1-7)

WEATHER:
- TEMPERATURE: - 30°C
- WIND SPEED: < 5 knots
- WIND DIRECTION: NW
SKY: clear and scattered

CLOUDS AND OBSCURING PHENOMENA:
Cl - cirrus

NOTES:
Excellent visibility. High confidence that all muskox groups were seen on Minto and Melbourne Islands. Therefore muskox seen likely represent a total count of animals. Caribou were abundant; mostly cows and subadults observed.